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ENGINEERING AND MINING JOURNAL

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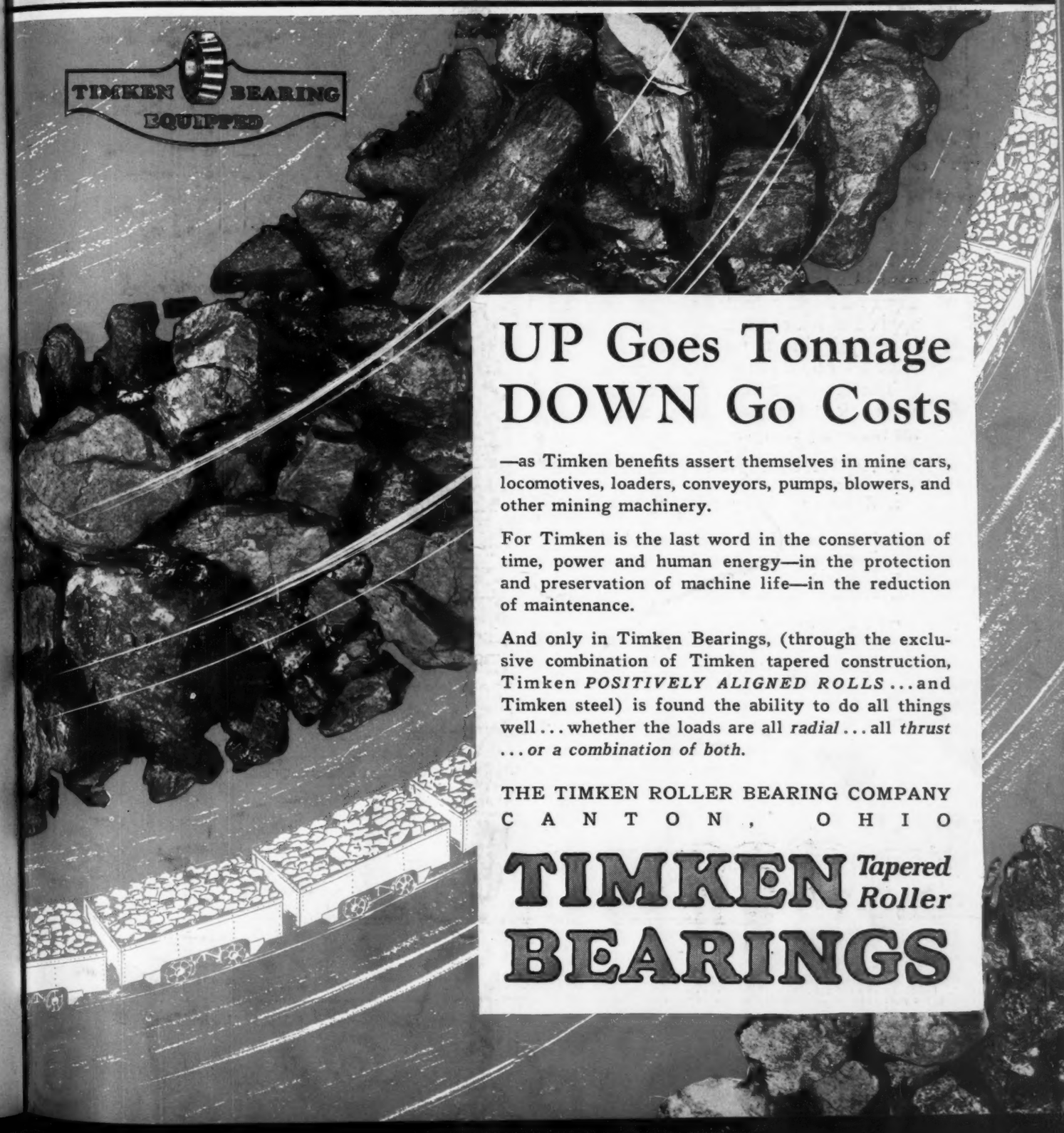

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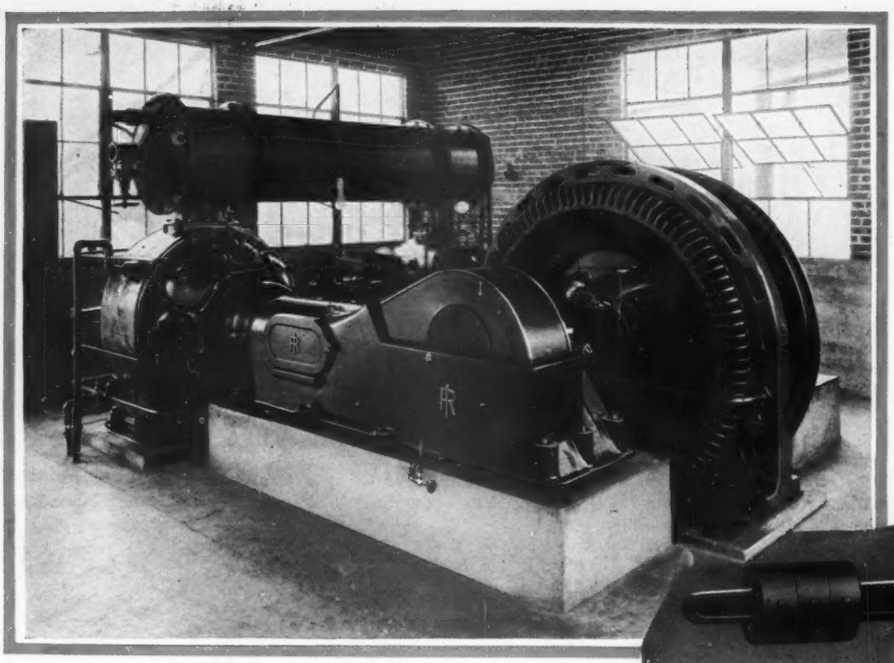

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Associate Editors: E. H. ROBIE, A. H. HUBBELL, New York. GEORGE J. YOUNG, San Francisco
Assistant Editors: W. N. P. REED and H. D. KEISER, New York. *Market Editor:* H. H. WANDERS. *Publishing Director:* H. W. CLARKE

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Curtailment of Production or Expansion of Consumption?

CURTAILMENT of production, a favorite topic of discussion in the mining industry recently, may be of two kinds, one being to maintain or to increase an artificial price, and the other a constructive step to stabilize a fair price, such curtailment being an intelligent effort to adjust production to estimated consumption. Fortunately, the first kind gives no present need for worry; it is the latter type that the mining industry has in mind.

Copper, tin, and to a less extent zinc, have been the metals about which most of the talk and action have centered. English tin interests have watched with considerable dismay the gradual drop in price from seventy cents at the beginning of 1927 to less than forty-five cents in recent months, in spite of the purchase by nonconsumers of surplus production. So an association of producers has been formed, and a definite announcement of curtailed operations has resulted. It is thought that the present and recent expansion of tin mining will not continue, but that the time will soon come, perhaps in a year or two, when a stationary or declining production will not suffice to provide for an expected increasing demand. For this reason, as regards tin, the sources of known supply of which are limited, an effort to widen uses rather than to curtail production is probably not justified at present.

Conditions in copper are different, though here, too, recent curtailments made by individual producers are likely to be temporary only, perhaps being made necessary by a too-sudden increase in production last winter, and by a change in buying practices. No decrease in the consumption of copper has yet been reported. In fact, both production and consumption seem likely to increase in the next few years much more than will the production and consumption of tin. Zinc production has declined to some extent in the last two or three months, but no concerted effort to limit production in accord with demand has been made, except in London and in the region tributary to Joplin, Mo.

Limitation of production by group action is legally discountenanced only in the United States, where it would run afoul of the Sherman Act as a combination in restraint of trade. Fortunately, however, by having complete trade information available, metal producers in the United States, and especially copper producers, are now showing a greatly increased ability and inclination to adjust their activities to the demands of industry rather than to carry on cut-throat competition in which only the biggest and most powerful corporations could survive.

Also, one is happy to note that copper producers particularly are continuing their most excellent efforts to expand the consumption of their metal; to find new uses for it. Success in this direction will make any present curtailment, necessary as it may be for the time being, purely a temporary measure. By the end of the year it may well be necessary to resume the former rate of production or to expand it still further, with an accompanying reduction in costs, as a result of larger operations. Maintenance of the price during a temporary lull in demand is preferable, as a furtherance of economic stability, to the conditions that have so often obtained in the past, when curtailed demand occasioned lessened production at higher unit costs, but with markedly lower prices for the product. When operations were active and costs low, prices were high. It was either a feast or a famine.

A more intelligent conduct of the industry is now in evidence. Those who cannot reconcile themselves to the maintenance of copper prices when the demand is dull may be as surprised if prices should not advance when buying becomes active. In fact, with operations at or near an efficient capacity rate, it may well be that as satisfactory a profit may be made with the selling price slightly lower.

A desirable attitude, therefore, is to consider curtailment of production as only a temporary expedient to meet a current general industrial condition, and to concentrate the heavy thinking on the more constructive step of expanding consumption.

British Columbia Adopts Training System for Engineers

VARIOUS measures have been employed in different countries for creating and maintaining high standards in the practice of professional engineering. In some, the influence of technical societies is paramount; in others, a series of examinations, prescribed by law, is more important. But common to nearly all methods now used to accomplish the desired result is a notable weakness—the lack of a formal, well-defined system of education and training for the engineer. An intelligent effort to satisfy this want has apparently been made recently by British Columbia under the terms of an Engineering Act. This law, in addition to requiring the registration of professional engineers, provides that all persons so registered shall constitute "The Association of Professional Engineers of British Columbia," which body is endowed

with authority to control the examination and admission of candidates to the study and practice of professional engineering. Means are provided under this system whereby the engineering graduate and the student with training in the practice of engineering can be distinguished and differentiated, and each recognized as a professional man in the making. To this end the association offers three grades of registration—(1) final professional status or license, (2) engineer in training, and (3) engineering pupil. The corresponding examinations are (1) professional final, (2) intermediate, and (3) preliminary. The practically trained youth of seventeen years may file his name with the association on being sponsored by his employer; at nineteen he may take the preliminary examination; at twenty-one or twenty-two, the intermediate; and at twenty-five to twenty-seven, the final or professional examination. The university graduate is exempt from the preliminary and intermediate examinations, and, provided his technical training has been approved by the association, the ordinary final examination is not necessary in full. A modified syllabus, more suited to the needs of the university-trained man, is used.

In its intention to insure sound engineering practice and to develop capable engineers, the association can well be commended. Also, its efforts to restrict the use of the term "engineer" to those legally qualified to adopt it will receive endorsement by the engineering fraternity. Particularly noteworthy, however, is the educational system planned by the association. This prescribing and enforcing of a formal procedure of training for all who would become members of the profession, and the legal recognition of the training when it has been acquired, must react to the benefit of the industries of the province, as well as to the members of the association. Assuming the whole-hearted and deserved support of the engineers of British Columbia, the Engineering Act should be an important factor in effecting an orderly and efficient development of the resources of the province.

The Growth of Distribution of Industrial Gases

ONE of the stock practical jokes of the old-time shop was to send the green apprentice on a "wild-goose" chase for a pail of steam. Times have changed. No merriment is excited today by a request for a cylinder of gas. Oxygen and acetylene, put up in modern "packages," have become such common shop supplies that they draw little comment or attention. Wherever welding and cutting are done by gas the cylinders are to be found.

Few stop to think of the organization of industry that makes possible the ease with which these once-unheard-of commodities can be laid down at the plant, without more ado than if the receptacles were so many kegs of nails. This organization has taken a decade or more in reaching its present efficient stage. Broadly speaking, two large manufacturing and distributing concerns, competing on a national scale, handle the bulk of the business of supplying the gases. One has about forty-five plants strategically located throughout the United States for making and distributing acetylene, and is continually adding new ones. The number of oxygen plants controlled by this producer is even greater and is likewise growing. The other manufacturer can point to similar achievement.

These ever-lengthening chains of "gas stations" are a new phenomenon of which the public in general is scarcely aware. They reflect the enormous growth in the use of heat for joining and cutting metal in order to repair, fabricate, and demolish in a way undreamed of by earlier generations.

What Is the Action of Lime in Flotation?

A LITTLE MORE than a year ago Mr. S. E. Stein, of the Southwestern Engineering Corporation, wrote an article for these columns on the use of lime in flotation, which summarized the experience gained up to that time, but in which he emphasized the fact that "little is known about the reactions by which lime accomplishes its purpose" and spoke of the need for "a more thorough investigation as well as the collection of available data from diverse sources." The research staff of the United Verde Copper Company has since been working on this very problem and has generously made its results promptly available in a recent publication of the A.I.M.E.

Addition of lime to the ore pulp, in the quantities customarily used, secures the presence of a definite amount of free calcium hydroxide, which, in turn, attacks the surface of a sulphide mineral like pyrite, even in the absence of oxygen. It seems probable that calcium sulphide, polysulphide, or thiosulphate is formed, and that the iron takes the form of ferrous hydroxide. Though freshly cleaned pyrite is more easily floated than galena, this reaction with calcium hydroxide alters its surface to such an extent that it is floatable with even more difficulty than is sphalerite, and thus "dropping of the pyrite" in selective flotation becomes better understood. Sphalerite, apparently, is not particularly affected by this alkaline reagent. It is just naturally hard to float, so must usually be plated with a thin film of copper sulphide.

The reaction mentioned results of course in the gradual reduction of the causticity of an alkaline ore pulp on standing, with accompanying increase in the calcium sulphide content of the solution so long as any free calcium hydroxide remains; thereafter the calcium sulphide oxidizes by contact with dissolved oxygen. Now, one might think that the generation of such reducing agents in an ore pulp would have a beneficial effect on flotation, but the United Verde experience is that they do not. Perhaps they might on some oxidized minerals. The important effect of conditioning with lime and air, in these experiments, seems to be the formation of an oxidized film of solid material, such as ferric hydroxide.

The amount of lime consumed, as well as the metallurgical results secured, are obviously of importance, for lime costs money. Several factors are involved, among them being reaction of the lime with metal

sulphates or sulphuric acid formed before or during flotation treatment; reaction with constituents of the water, thereby softening it; combination with carbon dioxide in the air; interaction with acidic constituents of the gangue; and adsorption. Research work indicates that "each mineral involved removes lime from its solution in the mill water in an amount depending on the amount of lime present, and that this amount is specific for each mineral."

The effect of oxygen in the reactions suggests the advisability of further work in the absence of oxygen, or in the presence of other gases, where definite flotation problems must be solved. The presence of oxygen favors the depression of pyrite, but in the United Verde work it also seems to favor the floating of chalcopyrite and marmatite.

One more interesting point, in the paper mentioned, is summarized as follows: "Where alteration of the surfaces of mineral particles by action of dissolved chemicals is a prerequisite to good flotation, it will pay to condition in as thick a pulp as possible in order to use the highest possible concentration of the conditioning agent."

The work at Clarkdale is continuing and should be stimulative of similar research elsewhere, on ores of different character. Too much empirical practice has long been evident in flotation. It is encouraging to see commercial organizations asking the physico-chemist to aid the millman.

Rhodes' Ideals Live in His Scholars

RECENTLY a young man of twenty-four years—Frederick John Siebert, Jr.— died of meningitis after a brief illness. He was the son of a mining engineer, and had just completed the second year of a Rhodes scholarship. Ten days prior to his death he had arrived in the United States from England on a lecture tour in behalf of international peace. His efforts for the furtherance of the spirit of world fellowship are said to have probably aggravated his illness, and an associate is quoted as saying that "Mr. Siebert, in the opinion of those who had the opportunity of judging his work, was one who in no unreal sense died for his ideals."

Little consolation, perhaps, can be found to mitigate the loss that will be felt by many in the death of one so young, who had given so much promise of valuable accomplishment in future years. Nevertheless, some comfort may possibly be gained from the fact that Siebert died endeavoring to further the principles that Cecil J. Rhodes—British statesman, mining magnate, founder of the Rhodes scholarships—manifested in the will establishing the scholarships; namely, those aspirations that make for the enlightenment and peace and union of mankind.

It is significant that Rhodes' financial means for furthering the principles so clearly evident in his will were derived chiefly from mining enterprises, and that these same principles should be advanced by the son of another member of the mining fraternity who was holding one of the scholarships. Such is the heritage of the world from the mining profession.

Synthetic Gems and Artificial Diamonds

IN A RECENT issue we discussed developments at the General Electric laboratories, with particular reference to the use of X-rays in the analysis of gems. Our informant at Schenectady used the phrase "synthetic diamonds" in referring to brilliants the spuriousness of which was evidenced by the new method of testing.

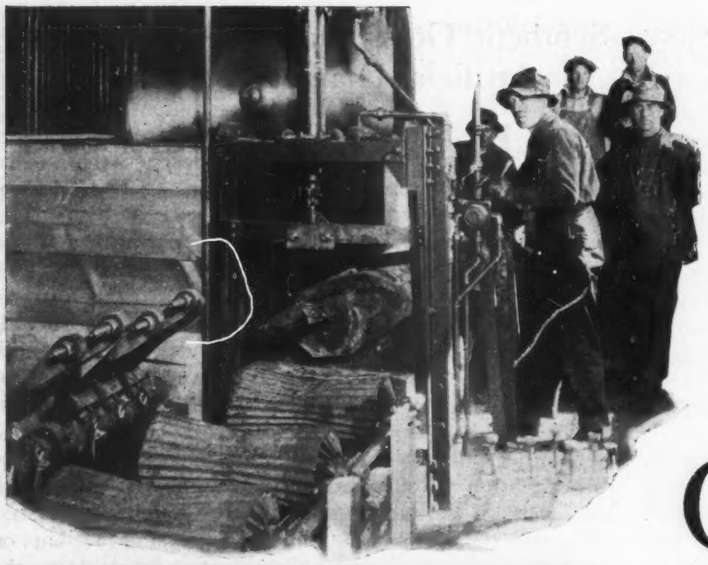
The Schenectady story was distributed far and wide and the reference to "synthetic diamonds" received excellent publicity. Promptly, however, came protest. One who knows diamonds as well or better than anyone else in the world grouped *Engineering and Mining Journal* with other publications and chided us for aiding in the dissemination of an error, the consequences of which might be of serious import to the diamond industry. Over the telephone we confessed culpability; but on further examination we find justification in changing the plea to one of "not guilty." The editorial in question averred that "With synthetic gems it is possible to determine the factory of origin by their reaction to the cathode rays. Research has also demonstrated that artificial diamonds turn brown when placed in the path of the rays, whereas the natural stone remains unaltered in appearance." We were not satisfied with the wording of the report that emanated from Dr. Coolidge's laboratory, and we substituted "artificial" for "synthetic" when reference was made to the diamond. The editing proved to have been justified. The diamond industry need have no apprehension. Even the various wizards of Schenectady have not been able to put science and its handmaiden—electricity—to work in producing real diamonds in commercial quantities and sizes, and at a cost that would indicate competitive possibilities.

However, opportunity is provided to discuss the meaning of a word that is used far too loosely, especially by the newspapers. Even our esteemed contemporary, *Chemistry and Industry*, from whose editorial columns we derive both satisfaction and entertainment, falls into the common error of using the term "synthetic nitrogen." The bogey of "synthetic gold" crops up at intervals, to frighten the miner of the precious metal. Now we hear of "synthetic diamonds," and the mention creates shivers down the backs of the diamond merchants and down both exposed sides of those members of the fair sex who delight in a costly display of the genuine gems.

However, all concerned can be of good cheer. No one will ever make a synthetic diamond or synthetic gold or synthetic nitrogen. Such a task is beyond human ingenuity. The popular misapprehension to the contrary is due to a slovenly use of the English language, and by a neglect to appreciate the fact that a synthetic substance is made up of two or more elements. A compound may therefore be manufactured synthetically, but not an element; and carbon, of which the diamond is composed, or gold, or nitrogen, is an element. A sapphire, on the other hand, is a variety of corundum, aluminum trioxide, and therefore capable of synthetic manufacture.

The gem industry is entitled to protection from the effects of synthetic scares. The best way in which misconceptions can be avoided is to use words in their primary and correct sense. An artificial or a synthetic product may be as good as the one it is intended to displace, but it will always remain an imitation of Nature's handiwork.

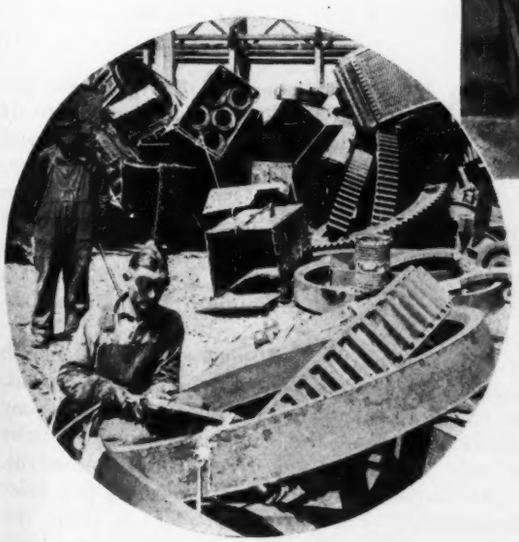
Some of the Butte Mines



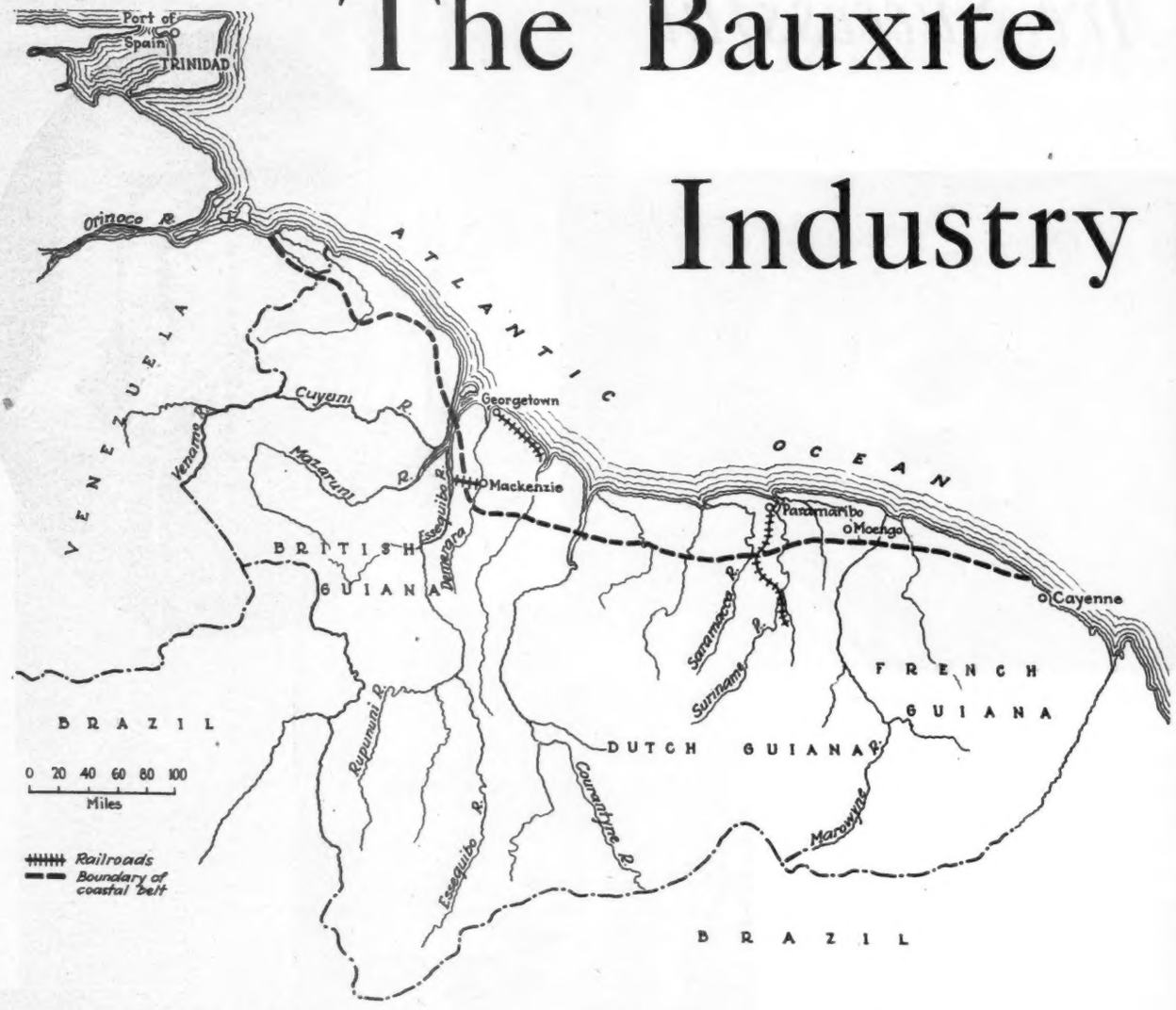
ONE of the chief operating centers of the Anaconda Copper Mining Company is at Butte, Mont., and unusual interest in this enterprise is being shown, because next week's issue of *Enginering and Mining Journal* will be entirely devoted to the historical, economic, mining, metallurgical, and marketing divisions of the subject, both in the United States and abroad. Some phase of the work at the Butte mines are pictured herewith. The ore can be seen in some of the illustrations. It averages approximately 4 per cent copper. The equipment is modern: the improved drilling machines, drill bits, drill steel, drill sharpeners, and air hose; the best timber for the purpose and modern timber-framing equipment; the latest types of electrical locomotives and cars. One photograph shows what happens to obsolete equipment: it is thrown away, but by the use of another modern tool—the oxy-acetylene torch—a part of it is reclaimed for other purposes. Note the character of the men in each of these pictures.

The minimum wage at Butte is $5.50 a shift, and a large proportion of the men own their homes and come to work in their own cars. And yet American copper is exported in large volume, and can compete with that produced anywhere else in the world.

Reasons Why ____ *Are Successful*



The Bauxite Industry of N



THE purpose of this article is to describe the contiguous colonies of British Guiana and Dutch Guiana, in northern South America, with particular emphasis on their important bauxite deposits and those general features that have affected the development of the bauxite industry there. Development of these deposits has taken place within the last fifteen years, and the two colonies together now supply over one-fifth of the world's total production of bauxite.

Adjoining Venezuela on the east is British Guiana, sometimes also called Demerara, after the name of its principal county. The capital of the colony and the only important seaport is Georgetown, lying at the mouth of the Demerara River. About 64 miles upstream from Georgetown on the same river is the town of Mackenzie, where a bauxite milling and loading plant has been established; lying close to the river 10 miles still further upstream and connected with Mackenzie by a narrow-gage railroad is the Three Friends bauxite mine. Demerara River is navigable as far as Mackenzie for ocean-going steamers drawing not more than 17 ft. The Demerara Bauxite Company, Ltd., operating this mine and plant in British Guiana, has been actively engaged in mining and shipping bauxite since 1917, with the exception of one or two temporary shutdowns, caused by general business depressions. At first, shipments consisted of crude ore as mined; later the bauxite was crushed and dried; and, beginning with the year 1923, it has also been washed before drying. Demerara Bauxite is a subsidiary of Aluminium Limited, a Candian corporation.

Similar topographically and geologically to British Guiana and adjoining it on the east is Dutch Guiana, sometimes called Suriname. The capital of this colony is Paramaribo, lying on the Suriname River, 8 miles from the sea. Another large river, the Commewyne, flows into the Suriname River from the east a few miles below Paramaribo. The Cottica River, a deep and narrow tributary of the Commewyne, rises a few miles from the eastern boundary of the colony, and flows westward into the Commewyne, paralleling the coast. On the Cottica river, 100 miles by river from the sea, but

A comparatively recent development in the British and Dutch Guiana colonies now supplies one-fifth of the world's production of bauxite . . . Historical outline, with topographic details . . . History and government of the colonies . . . Means of internal communication . . . Genesis and geology of the bauxite deposits . . . Description and analysis of the ore . . . Specifications and industrial requirements

# of Northern South America

By Laurence Litchfield, Jr.
Geologist, Republic Mining & Manufacturing Company, Pittsburgh, Pa.

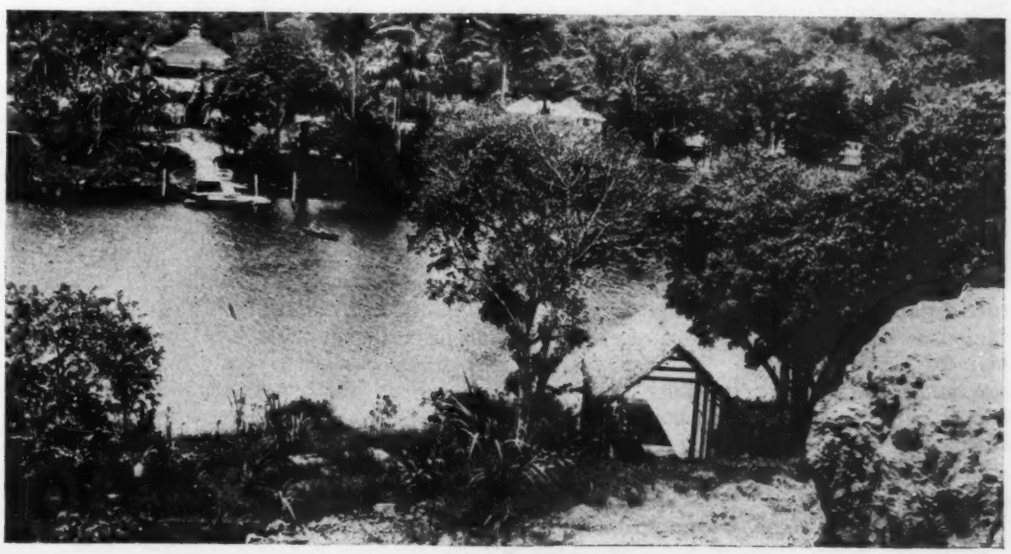
only about 20 miles from the coast as the crow flies, is the bauxite mining and milling town of Moengo. Ocean-going vessels drawing not more than 17 ft. and not longer than 340 ft. can proceed to Moengo to load bauxite. The Surinaamsche Bauxite Maatschappij, operating in Dutch Guiana, has been shipping bauxite since 1922, but prior to 1927 the material shipped was crude ore. A washing and drying plant was completed in January, 1927, and since that time the company has been steadily shipping crushed, washed, and dried bauxite. Surinaamsche Bauxite Maatschappij is a subsidiary of the Aluminum Company of America.

The two colonies are similar from many points of view—topographic and geologic, climatic and economic. They are both colonies of European countries that have extensive possessions in other parts of the world, particularly in the East. Both of these European countries have had similar problems to face in the development of these South American colonies; and since the abolition of slavery they have both had difficulty in keeping the two colonies on a self-supporting economic footing. It is interesting to note that in each colony it has been found necessary to augment local labor with importations of labor from the East; so that a substantial percentage of the total population of British Guiana comes from India, and in Dutch Guiana there are many thousands of East Indian coolies and Javanese.

Because of their position on the coast and consequent accessibility to colonization and settlements, the Guianas have had a continuous association with white activities since the beginning of the sixteenth century. Owing to their limited economic possibilities, development has proceeded slowly. The interior is nearly as untouched today as it was in 1530 when Pedro de Acosta, the first white man to set foot on the Guiana coast east of the Orinoco, started a Spanish settlement on the Barima River.

Successive Dutch settlements were started on the Pomeroon, Essequibo, Demerara, and Berbice rivers, in what is now British Guiana, from 1580 to 1674. The English—and to a lesser degree the French—meanwhile had been attempting settlements at Cayenne, in what is now French Guiana, and at Paramaribo; and by 1652 the English had large interests in both these districts.

During the seventeenth and eighteenth centuries we



Demerara River at Three Friends mine, British Guiana. Bauxite outcrop in foreground.

Cultivating rice in Dutch Guiana. Water buffalo in service.

find an involved story of attacks and counter attacks among the European settlements along the Guiana coast, reflecting the troubled times existing in Europe during this period. But in 1668 Suriname was ceded to Holland by the Treaty of Breda and has remained a colony of The Netherlands since that time. The Netherlands also retained the colonies of Essequibo, Demerara, and Berbice, constituting what is now British Guiana, until 1814. After changing hands several times between 1732 and 1814, these three colonies were officially ceded to Great Britain in 1814 and 1815, and in 1831 they were united in what is now British Guiana. The year 1831 therefore marks the real beginning of the history of British Guiana as we now know it.

Slaves were emancipated in British Guiana in 1838. In Dutch Guiana slavery was abolished in 1863. In both colonies the freed negroes demanded higher wages than the planters could afford to pay, and this resulted in attempts on the part of the British and Dutch to import cheaper labor from their Eastern colonies. More than a third of the present population of British Guiana comes from India. About 45 per cent of the population of Dutch Guiana comes from the East Indies, particularly from Java.

The population of British Guiana in 1925 was about 304,000, of which about 125,000 were of Asiatic origin. The remainder is made up of whites, negroes of African origin, indigenous Carib Indians, and mixtures of the various races. The chief executive power is vested in a Governor appointed by the King of England. In legislative matters the Governor is assisted by a Legislative Council, of which he is president. This body consists of ten members who are officials of the government, five members appointed by the Governor, and fourteen members elected from the various constituencies. Georgetown, with about 60,000 inhabitants, is an attractive modern city with tram lines, electric lights, moving pictures, golf, cricket, tennis, and football clubs, and a famous botanical garden. Most of the city is built below high-tide level, which complicates the questions of drainage and sewage. For drinking water the city relies almost entirely on rain, each house having its individual reservoir. The ground being low, most of the houses are raised on pillars. Georgetown is about twelve days by steamer from New York.

Dutch Guiana has a population of about 112,000, of which roughly 2 per cent are Europeans. Of the rest, about 45 per cent are of Asiatic origin, 19 per cent are Bush negroes or Djoekas, and about 2 per cent are native Indians of Carib origin. The remainder, indiscriminately called "natives" or "Surinamers," are mixtures of white and colored races. The executive power in Dutch Guiana is vested in a Governor appointed by the Queen of Holland. In administrative matters the Governor is assisted by a Privy Council consisting of four members. Legislative matters are handled by a group of electives known as the Coloniale Staten.

Paramaribo, the capital and principal port, with a population of about 45,000, is an old city built on a sand reef adjacent to the Suriname River. The city is on relatively high land, and most of the houses are built directly on the ground rather than being raised on pillars, as in Georgetown. Paramaribo is lighted by artificial gas, and, like Georgetown, depends on rain for its drinking water supply.

Communications and Industries

In the order of their importance, the principal means of communication in both colonies are (1) rivers, (2) railroads, and (3) roads. As can be seen from the map, the region as a whole is well drained by large rivers, which are the easiest means of communication with the interior in both colonies. Although most of the larger rivers are deep where they traverse the coastal belt, all of them have sand or mud bars across their mouths. These bars limit the draft of steamers entering the colonies to about 17 ft. A steamer which can cross the river-mouth bars on the larger rivers can penetrate a considerable distance into the interior. The current in most of them is sufficiently strong to scour a deep channel in the loosely consolidated sediments, but not strong enough to widen the river bed, because the banks in most instances are held by a solid mat of vegetation which protects them from erosion. Steamer services are maintained by the two governments on many of the larger rivers. In their upper reaches, motor boats and dug-out canoes bring out the gold, diamonds, and balata, which are the principal products from the interior.

Construction of roads and railroads in the settled portions of the two colonies is rendered difficult and expensive by reason of the low swampy nature of most of the country, and the many streams, large and small, which

must be crossed. Furthermore, thus far there has been little to justify the heavy investment, so that the mileage of roads and railroads under operation is relatively small.

The principal railroad in British Guiana is the East Coast Railroad, running from Georgetown eastward to Rosignol, on the Berbice River, a distance of about 60 miles. The most important diamond mines and gold fields are located on tributaries of the Essequibo River. An 18-mile railroad, called the West Coast Railroad, runs from a point on the Demerara River opposite Georgetown to Parika, at the mouth of the Essequibo River, where steamer connection is made with Bertica at the junction of the Mazaruni with the Essequibo. About 60 miles south of Georgetown the Demerara and Essequibo rivers pass within 18 miles of each other, and another short railroad has been built from Wismar, a small station on the west bank of the Demerara River, across this narrow divide to Rockstone, the corresponding point on the east bank of the Essequibo. Several motor roads are to be found around Georgetown, and a good road runs from this city eastward along the coast to Springland, on the Courantyne River, a distance of slightly over 100 miles.

In Dutch Guiana is a one-meter-gage railroad running from Paramaribo for about 100 miles in a southerly direction into the interior. This road was built between 1905 and 1909 to open up the country for an anticipated gold rush, which, however, did not materialize, and ever since that time the railroad has been suffering a heavy operating loss. Suriname has few long roads. In the immediate vicinity of Paramaribo are several good roads suitable for bicycles and light automobiles. A road is under construction between Moengo, on the Cottica River, and Albina, on the Marowyne River, which will put this latter easternmost settlement of the colony in closer communication with Paramaribo.

In British Guiana the principal industries are agriculture, gold and diamond washing, lumbering, and bauxite mining. The principal exports in the order of their value are sugar, diamonds, rice, bauxite, rum, copra, balata, molasses, and coffee.

In Dutch Guiana the principal industries are agriculture, lumbering, gold washing, bauxite mining, and the collecting of balata. The principal products are coffee, sugar, bauxite, gold, rice, timber, and balata.

That portion of the northern coast of South America which extends in an east-west direction from the Amazon River in Brazil to the Orinoco River in Venezuela is sufficiently uniform in its climate and physical aspects, so that a general description of these features will hold for British, Dutch, and French Guiana.

The similarity of climate in the three Guianas is caused by the northeast trade winds and the westerly ocean currents which sweep the coast. The climate is classed as tropical, with two dry seasons and two seasons of rainfall, distributed approximately as follows: "Small rainy" season, December to February; "small dry" season, March to April; "big rainy" season, May to July; "big dry" season, August to November. Average annual rainfall over the coastal belt would appear to be about 80 in., with a maximum of a little over 100 in. and a minimum somewhat below 70 in. Temperatures in the coastal belt vary from about 68 deg. F. to a maximum of over 90 deg. F., with the mean around 82 deg. F. in the shade. Temperatures in the sun have been reported as high as 164 deg. F. From January to May the northeast trade winds are a feature of climatic conditions, but winds of hurricane force, such as are experienced in the West Indies, further to the north, rarely if ever occur in the Guianas.

Topographically, the region naturally divides itself into three belts: (1) a flat low-lying coastal belt; (2) a broken foothills belt, and (3) an interior plateau region.

The Coastal Belt

Beginning at the mouth of the Orinoco River and extending eastward along the coast to near Cayenne, in French Guiana, is a flat low-lying area of recent sediments, which is called the coastal belt. Its width varies greatly. At its western extremity it is only a few miles wide, whereas at the boundary of British and Dutch Guiana the width increases to nearly 100 miles, gradually decreasing as one gets further east, until it finally pinches out near Cayenne. This coastal belt consists of clays and sands of recent deposition. The maximum thickness of these deposits is unknown; at Georgetown a well has shown that the granite-gneiss bedrock lies at a depth of 669 ft. from the surface, but it is not known whether this is a maximum figure. These sediments

Rafting timber down the Demerara River, British Guiana

View along water front at Paramaribo, Dutch Guiana

have been derived partly from the hinterland of the Guianas themselves, and partly from material brought down by the Amazon River and carried westward along the coast by the prevailing ocean currents.

Another coastal feature resulting from these westerly currents is seen in the westerly trend of many of the rivers in Dutch Guiana before they empty into the sea. Mud flats, and shifting sand and mud bars, extend about 10 miles seaward from the coast line. When approaching the Guianas from the sea, long before land is sighted, the water shallows and becomes turbid and yellow. This turbidity is caused by wave action on the shallow mud flats and also by very fine material carried in suspension from the mouth of the Amazon. The yellow color persists even in the rivers for some distance inland, gradually giving place to the characteristic clear dark-amber colored water of deep tropical rivers flowing for great distances, often, through regions of swamps and jungles.

There are few sand beaches along the coast, and sea bathing is almost unknown. Low ridges of mixed sand and shells some miles inland indicate that this part of the coast has emerged considerably in recent times. Along the southern limits of the coastal belt, before it merges into the foothills belt, is a narrow strip consisting largely of low quartz sand hills, and flat sandy areas, called savannahs.

The Foothills Belt

Back of the coastal belt is a broken region of heavily wooded hills. A great deal of the country rock of this region appears to be schist, with intrusions of various kinds of igneous rocks. Many of the hills are in the form of flat-topped plateaus with steeply eroded sides. The tops of these plateaus have about the same elevation, which leads to the conclusion that they are the last remnants of a former peneplain which was some 1,500 ft. higher than present sea level. Ferruginous laterite occurs as a capping on many of them.

Where they pass through the foothills belt, the gradients of the rivers are steep, and there are many water-power possibilities, which so far have been undeveloped because of the inaccessibility of the region and the lack of market for the power. One of the most notable of these potential water powers is the famous Kaieteur Falls, on the Pataro River, in British Guiana, which has a vertical drop of 740 ft.

Interior Plateau Region

Very little is known of the interior plateau region beyond the fact that in British Guiana it consists of a series of high grass-covered table lands, which would be suitable for grazing were they more accessible, and in Dutch Guiana of practically unexplored jungle-covered mountain areas. What little information we have of the far interior of Dutch Guiana has been brought by various scientific expeditions.

The bauxite deposits are found in what might be termed the intermediate zone between the coastal belt and the foothills belt. They occur as flat-lying or undulating lenses of varying size, usually overlain by clays and surface soils and resting on white, gray, pink, or mottled light-colored clays of unknown thickness. The amount of overburden in places may be 60 ft. or more. Locally, near the outcrops around the edges of the deposits, it may be only a foot or two in depth. Being more

resistant to erosion than the inclosing clay and sand, the deposits are usually encountered as low eminences, sometimes attaining the dignity of hills rising as much as 120 ft. above the surrounding country.

The genesis of the deposits has been the subject of much study and conjecture on the part of those familiar with them. It is certain that they belong to the type of deposits known as laterites, and as such would have been formed by the differential action of tropical atmospheric agencies on some original rock, the nature of which is not yet definitely known. Evidence indicates that the original rock from which some of these bauxitic laterites were derived is a schist. A deep pit put down at Three Friends mine, in British Guiana, discloses the fact that there is a gradation from good bauxite downward through bauxitic clays, then mottled light-colored clays, showing evidence of former schistosity, and finally decomposed kaolinized schist at the bottom. Decomposition of the original material has penetrated deeply, as the schist was encountered at a depth of over 40 ft. There is also evidence indicating that some of the deposits have been derived from other materials besides schist. At one of the Dutch Guiana deposits, a pit was put down through the bauxite to a depth of about 29 ft. From the surface to a depth of about 17 ft. the material encountered was bauxite. From 17 ft. to the bottom of the pit the material was white clay. About 26 ft. from the surface, a large residual boulder was encountered, consisting of coarse white mica crystals in a clayey matrix. Hexagonal crystals up to an inch in diameter were measured. The arrangement of the crystals suggested a coarse-grained syenite or even a pegmatite.

It is likely that the bauxite has been derived from several kinds of rocks, the deposits being the lateritized cappings of former coastal islands, or perhaps the remnants of a lateritic blanket which once extended intermittently over an elevated area of considerable extent. After the laterite was formed it is probable that the country was again gradually submerged, so that a considerable thickness of sediments was deposited in the depressions and lower areas of the former land surface, and a lesser amount of sedimentary material was deposited on the elevations.

The fact that the bauxite hills are higher than the surrounding country was of great aid in carrying on the search for these deposits in the early days. Everyone who has attempted geologic exploration in tropical jungles knows how hampered the explorer is by limited visibility. Being shut in on every side by impenetrable jungle growth, to get any ideas regarding the general topography of the region is almost impossible. Geological work is rendered even more difficult in the coastal belt of the Guianas by the lack of rock exposures of any kind. The only materials encountered are clays and sands. However, the first bauxite explorers in the Guianas located many deposits by climbing high trees with the aid of linemen's climbing irons, and from these vantage points spying out the country over the tree tops. Any considerable swelling in the sea of tree tops was suspicious and worthy of inspection. By getting its compass direction, and by following this direction on the ground, the swelling noticed in the line of tree tops was often found to indicate a corresponding rise in the ground surface beneath, and this latter in many instances led to the discovery of a bauxite deposit.

Bauxite deposits of British and Dutch Guiana vary greatly in size, from small lenses up to deposits several hundred yards wide and several miles long. Their thickness varies from 6 ft. to about 26 ft. The texture of the ore is usually porous or cellular. Though soft enough to dig with a pick, except at the surface, the material is yielding, and rather unsatisfactory from the standpoint of efficient blasting. Predominant colors are gray, cream, pink, and buff, grading into reds and browns as the iron oxide content increases. The structure of the deposits in the mass is usually homogeneous. In places, particularly in certain parts of the Moengo mine, in Dutch Guiana, the structure resolves itself into a series of boulders ranging from first size to that of a small room. The interstices between the boulders may be filled with fine bauxite, clay, or surface earth.

The amount of overburden varies from zero to a maximum of over 60 ft. In general, the average thickness of overburden in British Guiana is greater than in Suriname. Where the overburden is considerable, it is more usual to find the upper surface of the bauxite rather poorly defined; there is often a gradation into the overlying unconsolidated sediments. Where the overburden is thick, it consists of recent sediments in the form of bedded clays and sands of the coastal-plain series. Where thin, it consists of surface soil, mainly clayey or sandy loam. This is particularly true in British Guiana. If the overburden is only a few feet thick, or where it is lacking, it is more common to find the upper surfaces of the bauxite solid and hard. In such formations the upper foot or so is often more ferruginous and more indurated than the rest of the deposit, and this phenomenon holds for a great many tropical bauxite laterites. This is probably the result of changes caused by alternate wet and hot dry seasons. In the dry seasons the surface layers of the bauxite are dried out by the sun; capillarity draws upward into these dried-out portions the waters from below, which carry iron and sometimes silica in solution, these compounds being relatively more soluble than the alumina. These waters are dried off as they reach the surface, and the iron or silica held in solution is deposited at or near the surface. Thus we find a concentration of iron and sometimes of silica at the surface.

It is also common to find that the loose float material lying on a bauxite deposit of the lateritic type is extraordinarily high in alumina. This, of course, is logical, because these fragments have had the more soluble iron and silica leached out of them; and, lying loosely on the surface, they have not drawn from below the iron- and silica-bearing waters as above described. Sometimes, of course, ferruginous float material is also found; so that, as a general rule, it can be stated that surface indications of lateritic bauxite deposits are extremely unreliable and not indicative as to quality of what may be found by drilling.

The Guiana bauxites now being shipped are similar to Arkansas bauxites except for the generally lower silica content resulting from the washing of the Guiana ore. Analyses of the three bauxites are about as follows:

	Arkansas	Demerara	Suriname
Al_2O_3	57.0 to 60.0	61.0	59.0
SiO_2	4.0 to 7.0	2.5	2.0
Fe_2O_3	2.0 to 7.0	2.5	6.0
TiO_2	2.5 to 3.5	3.0	3.0
H_2O (combined)	28.0 to 30.0	31.0	30.0

While on the subject of bauxite deposits, mention should be made of the enormous tonnages of low-grade bauxitic laterite found capping many of the plateaus in the foothills belt of Dutch Guiana, and probably also of French Guiana. These laterites are high in iron and titanium, and low in alumina; and although of theo-

retical interest to the geologist, they are so unfavorably located and of such inferior quality that their ultimate utilization is problematic.

Most of the known high-grade deposits are fairly accessible to navigable rivers. Next, after the quality of the material itself, this feature has favored the development of the bauxite industry in the Guianas. However, although the location of the deposits has made inland transportation a minor item of expense, ocean transportation of the ore is severely handicapped by the shallowness of the harbor channels. This necessitates shipment in small steamers at relatively high cost, as compared, for instance, with ocean-freight costs on European bauxite, which is shipped to America on larger vessels and at ballast-freight rates.

In closing, it should be of interest to include a few notes on the quality requirements of commercial bauxite. In the first place, as might be expected, the available or free alumina in the form of the trihydrate should be as high as possible. This is the only constituent in the bauxite which can be used. The impurities, which are usually silica (SiO_2), iron oxide (Fe_2O_3), and titanium oxide (TiO_2), are harmful in varying degree, depending on the purpose for which the bauxite is intended. If the bauxite is to be used for the manufacture of aluminum sulphate, the iron oxide content should be as low as possible. For most uses the most objectionable impurity is silica, and as commonly found in bauxite it is in the form of one or several silicates of alumina, such as kaolinite and halloysite. Occasionally the silica is present as free quartz, either in the form of small broken veins running through the deposit or as sand from the overburden material. The Guiana ores are fairly low in silica; and, furthermore, this impurity is in such form as to favor a considerable beneficiation of the bauxite by washing.

Considering that Guiana bauxite is subject to higher freight to the principal American markets than the freight applying on European or United States bauxites, the Guiana ores must rely on superior quality to compete in these markets.

In subsequent articles the description of the bauxite mines and plants in the two colonies will be taken up in greater detail.

(To be continued)

Tin-Plate Scrap for Copper Precipitation

FROM the primitive launder, containing scrap iron in large pieces and small, to present-day practice in the precipitation of cement copper from cupriferous solutions or mine water, is a long step technically, although of short duration historically. A highly successful technique has been developed in recent years. The metal for precipitation must be chosen with the same care as is needed in the selection of zinc used in the cyanide process; and detinned tin-plate scrap, from the plants of the Metal & Thermit Company, has proved both efficient and economical. How this material is handled at the plant of the Utah Copper Company, near Copperton, will be described in an interesting article scheduled to appear in a forthcoming issue of Engineering and Mining Journal, written by Mr. Gail Martin, of Salt Lake City. Electric cranes play an important part in the procedure.

Tests Made on Copper Solutions

RESULTS of experiments on the solution of various oxidized copper minerals are outlined in Serial 2,934, recently issued by the U. S. Bureau of Mines. The paper is one of a series being prepared by the Southwest Experiment Station of the Bureau in cooperation with the department of mining and metallurgy, University of Arizona, dealing with factors involved in the leaching of copper ores.

John D. Sullivan, the author, points out that a knowledge of the time required to dissolve the various copper minerals present in ores, as well as of the consumption of leaching reagents, is very desirable, because with decreasing total tonnage of sulphide ores increasing attention is being given to the recovery of copper by leaching methods from low-grade disseminated ore containing both oxidized and sulphide minerals. As leaching has already been applied with success and profit, this study was undertaken to determine certain fundamental characteristics that are applicable to all ores suitable for leaching. Preceding articles have dealt with the ingress of leaching solutions into rocks and the removal of soluble copper from leached ores.

Results on one sample of azurite, one of malachite, one of tenorite, and five of chrysocolla are reported in the present paper. The results of the tests are summarized as follows:

Experiments have shown that the oxidized minerals of copper—azurite, malachite, chrysocolla, and tenorite—are soluble in sulphuric acid and ferric sulphate solutions. Approximately 100 per cent of the copper is soluble in one hour in sulphuric acid or acidified ferric sulphate solutions. In 1 or 2 per cent neutral ferric sulphate the dissolution is somewhat slower, but in nearly every instance the minerals are completely decomposed in 24 hours or less. The rate of dissolution in 5 per cent neutral ferric sulphate is about the same as in sulphuric acid or acidified ferric sulphate.

Chrysocolla is often said to be insoluble in sulphuric acid or in solutions containing ferric iron, but such insoluble silicates of copper are probably dioptase and not chrysocolla. The silicate portion of one specimen was found to be acid soluble.

The dissolution of chrysocolla and tenorite was practically the same in open bottles as in bottles from which the oxygen had been removed by oxygen-free nitrogen. Consumption of acid in dissolving the minerals is a little higher than theoretical. This is caused by the presence of impurities in the minerals, which consume the acid.

Exports of Chromite Low in 1928

CHROMITE exported in 1928, according to the U. S. Bureau of Mines, amounted to 214 long tons of ore containing 45 per cent or more of chromic oxide and 446 tons of ore containing between 40 and 45 per cent of chromic oxide, a total of 660 tons, valued at $14,807. Only 368 tons of chromite was mined in 1928, the remainder of the shipments having been made from stocks of ore mined in 1918. Only 201 long tons of chromite, valued at $5,063, was shipped in 1927. Imports of chromite were 216,592 tons in 1928, compared with 222,360 tons in 1927. Imports were principally from Rhodesia, Cuba, British India, Greece, and New Caledonia.

VERDE CENTRAL in PRODUCTION

By GEORGE J. YOUNG
Associate Editor

UNTIL January, 1929, the Jerome district, in spite of its comparatively long life, contained only two properties that were producing—namely, the United Verde and the United Verde Extension, the latter mine being in a faulted portion of the United Verde ore zone. The northerly extension of the United Verde ore zone is not promising, owing to structural conditions, but the southern extension has excited prospecting. The Dillon ground, now owned by United Verde, is the first property south of the United Verde; next is the Verde Central and further south is the Calumet & Jerome. Considerable geophysical prospecting has been done in the Jerome district south of the Verde Central, mostly on the Verde fault, as this was believed to favor ore deposition. As subsequently developed, however, the fault merely cuts the ore fissure. Much ore was shipped from the ground now owned by the Green Monster Mining Company and some from the Copper Chief and Shea properties, the latter being about 4 miles south of the United Verde mine. The Verde Central has been most diligently explored, and, as a result of consistent development, several important lenses are now being mined.

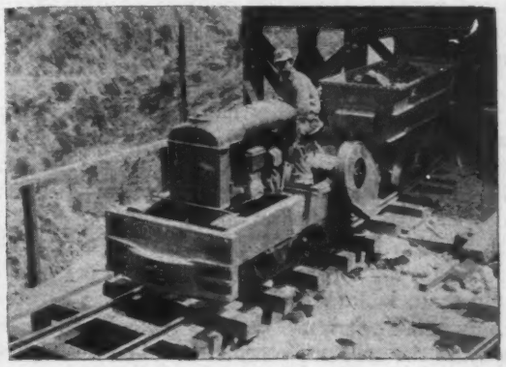
The deepest level of the Verde Central is the 1,900. Level spacing is about 150 ft. Exploration has been advanced north, south, east, and west. About 50,000 ft. of diamond drilling has been done to supplement the workings. Of interest is the fact that the results of diamond drilling have not been satisfactory enough to place the method in special favor. The largest orebody so far exposed has a stoping length of 1,000 ft. on the 1,100 level and has been developed on every level. It reaches a maximum width of 125 ft. on the 800 level at one place. At least three other lenses of minable size have been developed. Verde Central ore is found in greenstone, usually near the quartz-porphyry intrusive, which seems to be closely associated with the ore formation. The term greenstone is local and is applied to a series of volcanic flows and breccias with included intrusives. This series is considerably altered in many places to chloritic schist. At the Verde Central the greenstone is subdivided into five classes, ranging from rhyolite to amygdaloidal basalt, and some of these rocks are more susceptible of replacement by sulphides than others. The orebodies are vertical; walls are not regular, and ore limits have to be determined by sampling and close inspection. Likewise, barren and low-grade bars of rock occur, so that close attention is required in mining to maintain working grades.

The ore is exceptionally hard, an average of about 50 drills being required per drill shift. Drifters are C. P. No. 6, with 1¼-in. round steel. Self-rotation stopers of the Sullivan type are used in stoping, with 1-in. quarter-octagon steel. A vanadium alloy steel is used and has proved satisfactory, steel breakages being reduced to a minimum. Shrinkage stoping is practiced, the drilling depth being about 5 ft. Manways spaced 100 ft. apart are cribbed with 3-in. planks. Stopes have timbered bottoms of 3-in. planks, and sill floors are supported by square sets in wide portions and by posts and caps in narrow portions, caps being doubled for intermediate widths. Except for stope timbering, no other timber is required. Drifts and long crosscuts are without timbers. Chutes are closely spaced, being at 25-ft. intervals in places and at every other set in other places.

Generally, chutes are arranged so as to receive two ore streams, the space between being open so as to afford room for blockholing oversize pieces. A short ladder from the drift gives access to these "rooms." Board stops are used for chute control, as is also an upward swinging flat plate gate. A foot plank is placed opposite and above the chute lip to provide footing for the car loader.

Hand tramming, in 16 cu.ft. roller-bearing cars, is used for ore transportation to the shaft. For long-distance transportation, over 500 ft., a 1½-ton Goodman storage-battery locomotive is used. Ore cars are hoisted

Left—New mill of Verde Central



Right—Gasoline locomotive transporting ore from mine to mill

on two-deck cages to the surface, where they are dumped over a grizzly and into a pocket which discharges on an inclined belt conveyor, which, in turn, discharges into a bin. The upper portion of the conveyor is used as a picking belt.

About 5 per cent waste rock is removed from the ore. Provision has also been made for picking high-grade ore. About 700 tons of ore is broken in the mine per day, somewhat less than half of this being hoisted to the surface. As stoping was only started at the beginning of the year, no stope has reached the drawing stage. Consequently, only part of the ore broken can be drawn. Eighty men are employed underground. Stopes are being started on the 1,750, 1,450, and 1,100 levels, the present plan being to keep chute-loading levels 300 ft. apart vertically, the intervening levels being used for access to through raises.

Ore mined during the period of development was placed on the dump, and this is now being reclaimed by a large rake-type scraper operated by tailrope and hoist, the loaded cars being trammed through a short adit to the shaft and then hoisted. Dump ore is used as needed. The ore-receiving bins at the shaft are used to load a five-car train hauled by a gasoline locomotive to the mill receiving bin. V-body, side-dumping cars of about three-ton capacity are now in use at the plant for this service.

Change house, machine shop, drill-sharpening shop, shaft mouth, headframe, and compressor and hoist building are on the same level, a side hill terrace on the north slope of Walnut Canyon, which is a short distance southwest of Jerome and at a higher elevation. The headframe is of steel construction, and the shaft has three compartments. Hoisting is in two compartments, the third being utilized for pump columns and a steel-armored 2,200-volt power cable. The hoist is a double-drum type, direct-driven by a d.c. Westinghouse motor of 220 hp., receiving current from a 180-hp. a.c. motor, flywheel, and d.c. generator, the set being close to the hoist.

Compressed air is supplied by four compressors, an Ingersoll-Rand type PRE, 16½x18-27x18, direct-driven by a synchronous General Electric motor of 350 hp.; a short belt-driven Imperial Type 10 compressor, with a 150-hp. motor, and two smaller compressors, both belt-driven, one a single cylinder and the other a duplex type. The largest compressor was the only one in operation at the time I visited the plant.

The shops are well equipped for a mine of this size. Acetylene welding equipment for cutting and welding, pipe and bolt threading machine, power saw, drill press, and other tools are grouped in one shop. The drill-sharpening shop has two power sharpeners and an oil-fired forge. The large number of drill steels per drill shift makes the demand on the drill sharpening unusually severe.

Verde Central ore is hard and siliceous and contains about twice as much pyrite as chalcopyrite. It submits to flotation readily; the concentration ratio ranges from 7½ to 8 to 1, and the tailing averages about 0.2 per cent copper, the low point being 0.14 to 0.15 per cent. Extraction is 91 to 92 per cent, but E. M. Smith, mill foreman, said: "We are aiming at 96 per cent recovery," and I am inclined to believe that he will accomplish this high figure when the changes and rearrangements under way in the mill are completed. The mill is treating 200 tons per day, the degree of crushing being indicated by the screen analysis of one-half of 1 per cent on 48 mesh and 58 to 60 per cent through 200 mesh. Potassium ethyl xanthate, 0.07 lb. per ton; pine oil, 0.09 lb. per ton; and 1.6 lb. lime per ton represent the reagent consumption. Power consumption averages about 20 kw.-hr. per ton.

The mill was designed by J. E. Lanning. Its layout is simple—a receiving bin, 12x24-in. jaw crusher, delivery by conveyor to a set of 24x54-in. rolls in closed circuit with a 4x5-ft. Hum-mer screen, which discharges minus ¾-in. size to the fine-ore bin. A Symons cone crusher is being installed, and this will take the product of the primary breaker, delivering it to the bucket elevator serving the Hum-mer screen. Oversize will be sent to the rolls and discharged into the elevator boot. It is planned to use a ¼-in. screen and deliver to the ball mills a minus ¼-in. product. The operators expect by this arrangement to increase the mill capacity to about 300 tons per day.

Crushed ore is stored in a wooden tank-type bin of 200 tons' capacity. A roll feeder and a belt conveyor with weightometer delivers the ore to two 8x36 Hardinge mills in closed circuit with two 6x25-ft. Dorr classifiers. The overflow goes to two MacIntosh rougher cells (15-ft. rollers, 9-in. diameter) and the flotation concentrate to a cleaner cell of the same type with a double air control. A No. 2 Roots blower supplies air for the flotation machines. The flotation concentrate is dewatered in a Dorr thickener and delivered to a five-leaf, 6-ft. diameter American filter, from which the dewatered concentrates are delivered to a shuttle conveyor over the bin beneath. From this they are discharged into and handled by ten-ton six-wheel motor trucks to a loading bin and thence by railroad to the United Verde Extension smelter at Clemenceau.

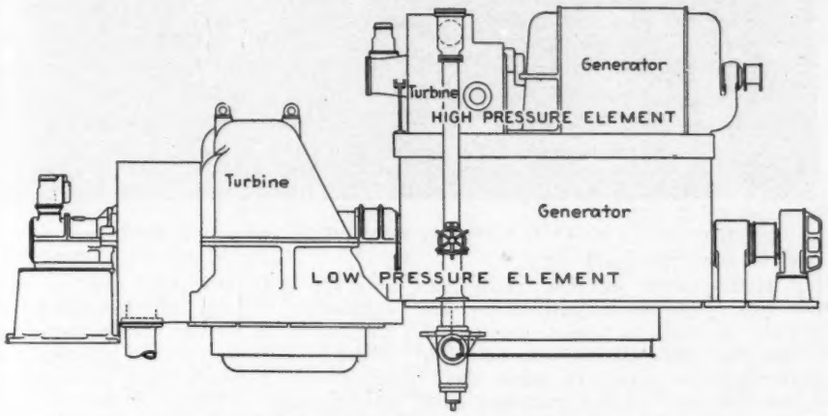
A 2-in. Wilfley pump is used for returning middlings, and a Byron-Jackson centrifugal pump returns water from the thickener. Miscellaneous equipment comprises a Geary auto sampler, Denver Equipment Company 10 belt line feeder, Galigher reagent feeders, and a belt-driven Sullivan vacuum pump. Tailings are delivered to a thickener, the underflow of which is delivered by a launder to a distant dump. The mine supplies about 100 gal. of water per minute, and this is pumped into a rectangular concrete-walled tank above the mill and furnishes the mill water supply.

Verde Central was incorporated in 1916, and subsequently W. F. Stanton directed exploration operations. In 1921 the Calumet & Arizona Mining Company acquired a large interest in the company by advancing funds for additional exploration and development. R. H. Dickson is manager of Verde Central and has been in charge of operations for some years. He was formerly superintendent at the Eighty-five branch and also was chief engineer for the Calumet & Arizona company at Warren. Mr. Dickson has made a thorough study of geological conditions at the Verde Central, and, as a result of persistent effort, has brought the mine to production.

Indicative of the expense involved in such a campaign is the fact that the development account up to Dec. 31, 1928, totaled $1,597,535 and the construction account, $300,995. During 1928, development work consisted of 7,740 ft. of drifting and crosscutting, 624 ft. of raising, and 6,182 ft. of diamond drilling.

COST-CUTTING INNOVATIONS

Combination of Natural Gas, High Boiler Pressure, and Improved Turbine Design Insures New Efficiency Record



Arrangement of high-pressure, double-deck compound turbine generator

SEVERAL unusual features will be incorporated in the steam-turbine generators to be added to the generating facilities of the Pacific Gas & Electric Company, San Francisco. The two machines, each rated at 50,000 kw., will be the first of the new double-deck compound type, the first high-pressure turbines on the Pacific Coast.

The station will be one of the most efficient in the world, the result both of employing 1,250-lb. boilers and using natural gas as fuel, piped 240 miles. Each main 1,200-lb. turbine unit, of General Electric manufacture, consists of a high-pressure element operating at 3,600 r.p.m. and a low-pressure element operating at 1,800 r.p.m. The turbines, each rated at 50,000 kw., are to be suitable for a maximum output of 62,000 kw. Provision is made so that the low-pressure turbine can be operated from the high-pressure boilers with the high-pressure turbine shut down.

A new type of construction will be used, in that the high-pressure turbine and generator will be mounted on top of the low-pressure generator, thereby saving the foundation and the floor space ordinarily required for the high-pressure turbine. The result is a compact unit. Since working out the design details, this type of construction appears even more advantageous than when first proposed.

In addition to the main turbines, two General Electric auxiliary turbines are included for driving the boiler feed pumps. These pumps, used with high-pressure boilers, absorb considerable energy, and therefore these turbines are much larger than usual. They are of the two-unit type, composed of condensing and non-condensing elements. The condensing element is coupled to one end of the pump and takes steam from the present 300-lb. boilers; the non-condensing element is coupled to the other end of the pump and takes steam from the cross-over between the main turbines. This arrangement permits the two elements of the turbines to be operated at times independently and at other times together, so as to maintain at all loads the most economical heat balance on the installation as a whole.

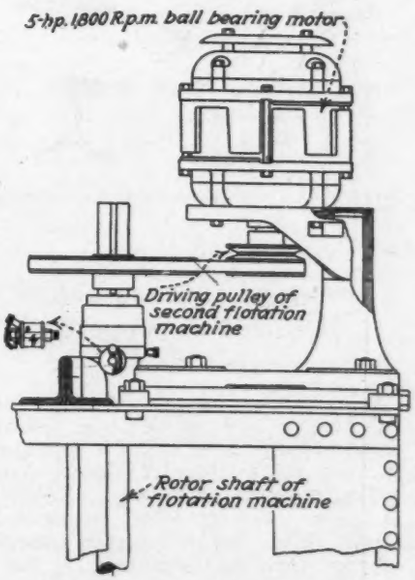
Sturdy Carpenter Horses

CARPENTER'S HORSES are usually made of wood and have a tendency to break or spread after they have been subjected to any hard usage. The plant welder of a large Eastern shop, realizing these facts, constructed a pair out of scrap angle iron. The finished product was an agreeable surprise to the carpenters. It was a simple task to weld these pieces of scrap together. The accompanying illustration clearly shows the construction of the horse and the location of the welds. The pieces were all welded with butt-type joints, and a small amount of welding rod was added for extra strength.

Carpenter horses made from scrap angle iron by welding

Single Motor Drives Two Flotation Machines

U. S. PATENT No. 1,680,843 describes a swivel mounting whereby one motor is utilized to drive two flotation machines. A standard 5-hp. motor is mounted on a swivel plate, which swings horizontally on a pin fixed to a pedestal on a base plate. This base plate is adaped to slide on the top angles of the frame of the machine and can be pulled backward by means of an adjusting screw for the purpose of tightening the belts. The motor is provided with a double-grooved pulley. Each motor drives two cells by means of endless V-rope belts, one belt for each cell. Because of the swivel mounting, the belt strains automatically equalize themselves; and if the belts need tightening this is readily accomplished while the machine is running by pulling the base plate backward by means of the adjusting screw. This arrangement provides



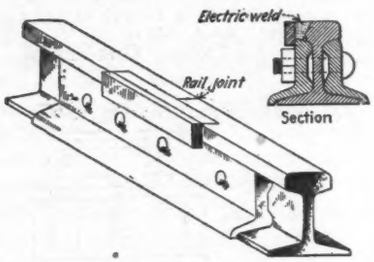
Modern mounting for double V-rope drive

a smoothly running and flexible mechanism free of any mechanical trouble.

The belts have a long life, are of standard length, and are easily replaced. The device is used by the Pan-American Engineering Corporation in the operation of Kraut flotation units.

An Inexpensive Welded Rail Joint

ON LINES in gravel ballast track that is not welded throughout, many bad joints may be reconditioned by an inexpensive method of welding, writes L. T. Botto, in *Electric Railway Journal*. The accompanying sketch shows the construction used. A part of the rail head at the joint is cut out on a bevel. A piece of boiler plate is then applied to the outside of the rail, and the space left by the portion that is cut out is filled in by welding. This forms a permanent joint between the angle bar, the rail, and the plate. It has been found that this weld does not pull apart in service, and that it makes a very smooth joint.



Details of a rail joint made by welding

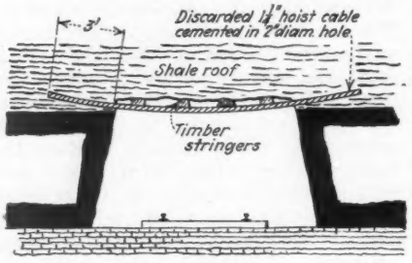
Discarded Hoisting Cables Utilized to Support Bad Roof

A METHOD of holding weak or broken roof through the agency of discarded hoisting cables is described in *Coal Age* by John A. Garcia, consulting engineer, of Chicago. Lengths of 1¼-in. hoisting cable on desired centers hold timber stringers placed between the cables and roof, as indicated in the accompanying illustrations. The ends of these cables are anchored with cement grout in 3-ft. holes of 2-in. diameter drilled tangent to the curve which the cable assumes on repose or on taking the roof load.

It is suggested that in placing the cable the drillhole be filled with the cement grout by means of a pipe and a wooden plunger. By this arrangement the cement is pushed in as the pipe is pulled out. To hold the cement in place while the cement is hardening a wooden wedge is driven against the cable at the mouth of the hole. If skillfully done, the cable can be hung quite close against the roof and tightened by cap pieces after the cement has set.

The cables shown in the accompanying picture were installed more than two years ago in a particularly bad stretch of roof to make the test a severe one. Mr. Garcia remarks, "On examining the place the other day I found that the roof had fractured quite high and that the cables were holding the roof satisfactorily.

"As to cost," he continues, "do your own figuring; it is negligible when compared to the cost of a cap and two legs and the labor of installing them.



Method of installing rope roof supports

Here also is a chance to get rid of the unsightly, and heretofore useless, discarded hoisting cables that are noted at many mines."

The editor adds a suggestion that where this system is adopted, particularly when applied to wet places, the ropes be carefully examined and lubricated or painted periodically to combat rusting. There is little likelihood of the rope pulling out from the holes when the cement anchoring is properly done.

After two years these ropes continue to hold badly fractured roof

Scrap Steel Nets Saving

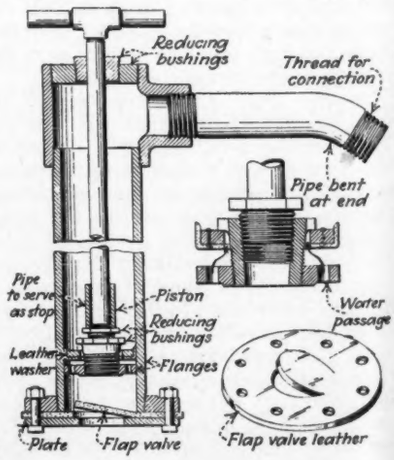
Cold chisels and similar tools can be made from all Ford rear-axle shafts, and crowbars from the drive shafts, writes R. M. Thomas, of Denver. This steel may often be purchased at a saving over the steel ordinarily used for such purposes. It can be machined, or worked in the forge, or hardened as desired. This steel should be bought as opportunity presents itself, as it can be used for many different purposes around a shop or plant.

Bailing Pump Made from Pipe and Fittings

A READILY MADE hand pump, put together hurriedly in one plant, to clear a flooded boiler room, is described by G. A. Luers in *Power*. It is made almost entirely of pipe, with the minimum of machine work and fitting. The foot valve contains a simple arrangement of leather flap valve. The piston is fitted with a leather facing and weighted closing valve.

Details will be clear from the drawing, and, as will be evident, the size can vary to provide a pump from almost any pipe parts that are to be found around the plant.

Assembly and detail of hand pump



COMMENT AND CRITICISM

The Small Base-Metal Mill

IS the operation of the small-tonnage, base-metal milling unit economically feasible? A metallurgical engineer calls for production and cost data, not forgetting interest and depreciation allowances, and he urges the industry to discourage experimentation that is doomed to failure.

To the Editor of "E.&M.J.":

During the last year *Engineering and Mining Journal* has printed valuable articles on the possibility of the profitable operation of the small mining property. To my mind, "small" means any capacity under 75 tons per day. If shipping conditions are favorable, the chances of success are far greater than if milling is necessary.

Unfortunately, however, our railroads did not select their right-of-ways to include undeveloped mining districts, and beneficiation of the ores becomes necessary for the small mine, if it will pay.

From my experience and travels, there are called to mind only two mills of under 75 tons which ultimately showed a profit, and both of these were operating on silver ore. One of these in Colorado was at first of 40 tons' capacity, making a silver-lead concentrate from 25-oz. heads. The cost of haulage, freight, and smelting was about $33 per ton of concentrate. At this capacity, however, the mill did not pay, but another small ball mill was added, increasing the capacity to 60 tons and improving the extraction, with the result that the operation paid very nicely—until the ore gave out.

The other plant was a twenty-ton silver flotation mill in Mexico, installed only for test purposes. Heads were always above 30 oz. Power cost was high, with other adverse conditions. However, the concentrate ran from 1,000 to 3,000 oz. per ton. During the second and last year of its operation, this test plant returned $55,000 out of the $60,000 placed in development. There is now a 450-ton mill on this property.

Note that both of these mills were operating on precious metals. It is hard to visualize the small mill paying unless there is considerable silver or gold in the heads.

A visit was made to one of these mills recently. There were three men in a crushing plant that handled 100 tons in eight hours. The equipment was good, but the design was wretched. One man was pulling ore out of the crude-ore bin onto a 16-in. rubber belt conveyor. The second man was pulling the ore down the feed chute to the primary crusher, and the third man was nursing the feed chute to the secondary crusher. This crushing operation was costing $7 to $10 a day more than it should have cost.

Another small-scale plant (35 tons) was recently installed at the railroad, at a point where the freight rate to any one of three smelters was not over $1.50 a ton; and this mill was 10 miles from the nearest mine. The milling cost of this plant would probably be $6 a ton. With the ore at the railroad, the profit, if any, would be greater from shipping and smelting than from milling in a high-cost low-extraction plant. This mill is now shut down.

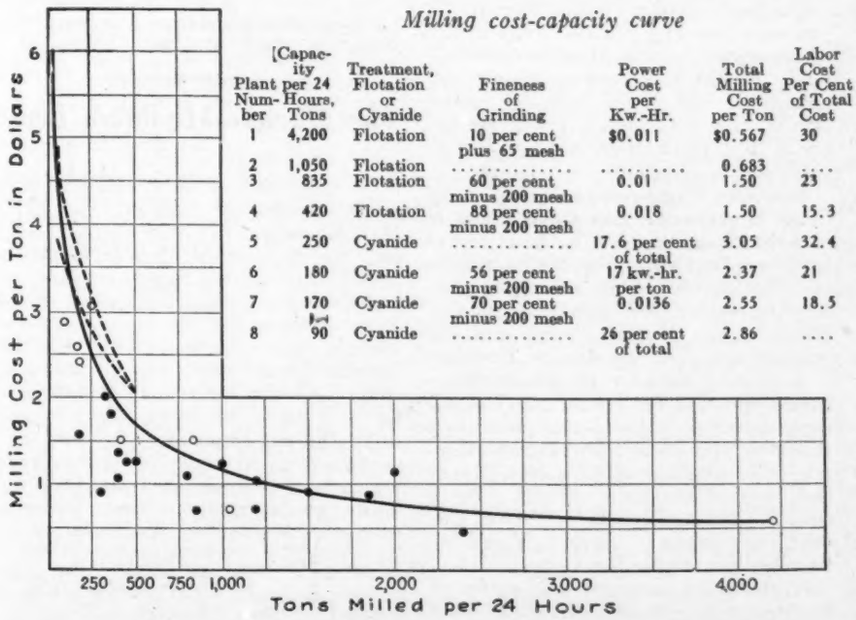
The news columns in *Engineering and Mining Journal* often have items regarding the installation of small milling plants, but it would be interesting to see a reliable report on the actual cost of milling in, say, a 25-ton plant. Are any of these mills operating on anything but precious metals, and are they really profitable? Were interest, depreciation, and depleted ore reserves written off against the profits, so that the mining investor will get his money back with interest? Or was this milling venture just another case of "The operation was successful, but the patient died?"

Milling failures do not help the mining industry. The effect on the public mind is the same whether these small plant failures are caused by ignorance or dishonesty.

Vague statements which occasionally appear as to the success of 25- and 50-ton plants have little effect on the men who know. They do, however, catch considerable money from the ignorant and the innocent, and another monument is erected to show how bad mining investment can be. Unfortunately, there seems to be a scarcity of accurate data on the operating cost of the small plant. Mr. Lewers, in the April 14, 1928, issue of *Engineering and Mining Journal*, tabulates a probable range for the small-plant operating cost.

Milling cost-capacity curve

Plant Number	[Capacity per 24 Hours, Tons	Treatment, Flotation or Cyanide	Fineness of Grinding	Power Cost per Kw.-Hr.	Total Milling Cost per Ton	Labor Cost Per Cent of Total Cost
1	4,200	Flotation	10 per cent plus 65 mesh	$0.011	$0.567	30
2	1,050	Flotation	.....	.....	0.683	....
3	835	Flotation	60 per cent minus 200 mesh	0.01	1.50	23
4	420	Flotation	88 per cent minus 200 mesh	0.018	1.50	15.3
5	250	Cyanide	.....	17.6 per cent of total	3.05	32.4
6	180	Cyanide	56 per cent minus 200 mesh	17 kw.-hr. per ton	2.37	21
7	170	Cyanide	70 per cent minus 200 mesh	0.0136	2.55	18.5
8	90	Cyanide	.....	26 per cent of total	2.86	....



The curve accompanying this letter is plotted for milling cost and capacity. The two costs for plant No. 3 and No. 5 have abnormal conditions of altitude or temperature, No. 3 being at 10,000-ft. altitude in a cold climate and No. 5 being in Canada. As plotted, the dotted curves are the range suggested by Mr. Lewers, and indicate a sane milling cost estimate.

Before spending $25,000 to $75,000 on the small mill, it would be well to spend sufficient money to have a competent and impartial opinion on both the mine and the metallurgical treatment. How much better to spend even $5,000 in cold-blooded investigation than lose $50,000 as a result of enthusiastic ignorance. W. A. LEDDELL.

El Paso, Tex.

Indispensable Engineers and the Professor

To the Editor of "E.&M.J.":

In one of your editorial comments of July 13 you quote a noted professor's advice to his graduating class, as follows: "Be a snob, marry the boss's daughter. Dress, speak, and act like a gentleman, and you'll be surprised at the amount of murder you can get away with." Presumably the amiable professor has proved out his theory himself, but I note he is professor of English and history and not of mining.

To accomplish speedily what he desires for his graduates I suggest that he get his state to pass a law giving all such graduates a title of "Enacted Engineer," so that after they are once graduated all persons must address them as Mr. Enacted Engineer. Something very similar is arranged in Spanish-speaking countries. Thus automatically they may become snobs and will become gentlemen; automatically they should be able to marry the boss's daughter. Endowed with this title they will somehow find funds to buy one suit of clothes of distinction; and, thus arrayed, can no doubt find suitable employment. If the work is a little dirty, they can wear a smock. There is now quite a variety of color schemes in smocks.

On my first trip to Mexico I was naturally interested in everything. I would try to get the name of every station on the line. We would come to a station labeled in big letters "Altura," then a station called "Comida," then another called "Altura," then one called "Mescal." Next, one perhaps named "Tequila," then looking out of the window I would see approaching another "Altura." Not understanding Spanish it took me some time to comprehend that "Altura" meant elevation, always an interesting thing to know in Mexico.

Some time later I had a job at a mine in another Spanish-speaking country and with us was a fellow who really never did anything. Everybody called him "Ingeniero." Not knowing Spanish perfectly, I thought that was his real name. Later it dawned upon me that no ordinary name could command such fawning attention. I asked the timekeeper who he was, and he said, "He is the *ingeniero indispensable.*" In my opinion the presence of this man on the staff tended to lower the efficiency of the whole mining operation because his title and the manner in which he was placed in his position enabled him to get away with all kinds of "murder."

Speaking of dressing well and being a gentleman: mining engineers can always afford to do and be that. Select wisely a suit costing $60, and it may last a good part of your career. We so seldom "dress up" that clothes last too long, especially in good climates like Mexico. Some years ago, in order to be able to make love to a boss's daughter, I bought an expensive evening dress suit, but at one of the dances I met another member of the fair sex who later brushed and took care of said suit. It was a narrow escape for me, as soon after the aforesaid incident the boss got fired.

When away from the mines in some big city and all dressed up looking for a job I am sometimes mistaken for a man of wealth. It all depends on the city. In Chicago, for instance, I was mistaken for the son of a millionaire. In San Francisco they have always dressed well since the days of '49. About all one can "put over" on them is something new in neckwear. Arriving in Los Angeles it is well to change to golf pants. They are impressive there. When the professor goes that way I hope he will remember this tip.

AMERICANO.

Somewhere in Mexico.

And Here Is an Explanation of the Incident

To the Editor of "E.&M.J.":

With reference to the editorial in your issue of July 13, entitled "Novel Professorial Advice for the Young Engineer":

Quoting one of my editor friends, "If you want publicity you need only to call somebody a liar or a damn fool." Professor Rogers surprised us all, perhaps himself as well, at the extent of public clamor over his words. I will not attempt to explain them, but ask you to visualize the occasion.

Professor Rogers was speaking at the Class Dinner—the last social event of undergraduate days. The next morning in cap and gown, dignified and serious, the boys would file across the platform to receive their degrees. But this dinner was informal—very—and its proceedings were not usually reported.

A popular member of the faculty—rare distinction for one of the English department, so popular that he enjoys the favor of a nickname: "Tubby" Rogers—was speaking at the Class Dinner and uttered startling advice, "Be a snob." Did they hear? Every one. Will they forget? Never! Good old "Tubby" got on the front page.

A university president was quoted in the Boston papers the next day. When asked by reporters to comment on Professor Rogers' advice, he found it "unbecoming" that he should criticise a member of the faculty of a neighboring institution. How serious; what want of imagination!

But one can be a "snob" without "marrying the boss's daughter." You will need only to speak English, as Professor Rogers does, and speak it that way at Murphy's Flat or Whiskey Gulch, to be a "snob" in the candid opinion of the denizens of these camps. Shall one run the risk of being thought a "snob" in Whiskey Gulch, or should he appear rough enough and tough enough to achieve renown in that already tough community?

Professor Rogers gave good advice which many of our young engineers need and will do well to heed. Better be a "snob" than to boast "I am wild and hairy and have never been curried below the knees." What are they called when they get that way? OBSERVER.

Cambridge, Mass.

A Correction

To the Editor of "E.&M.J.":

In a news note in the issue of July 6, concerning the purchase by U. S. Smelting, Refining & Mining of the properties of Bingham Mines, the statement is made that acquisition of these properties in Bingham will give U. S. Smelting two deep entries into its mines—the Butterfield tunnel of Park Bingham and the Mascotte tunnel of Ohio Copper. This statement is erroneous. The Butterfield tunnel belongs to the Lavagnino Conglomerate Company, from the portal of said tunnel to the boundary line of the Lavagnino Conglomerate Company property in a northwesterly direction, for a length of 9,166 ft.

Park Bingham never has had proprietary rights in the Butterfield tunnel, but is using this tunnel under an agreement with the owners.

E. LAVAGNINO, Secretary,
Lavagnino Conglomerate Company.
Pasadena, Calif.

The Missabe Mountain Lease

To the Editor of "E.&M.J.":

On page 707 of your issue of May 4, 1929, under the caption "The Hull-Rust-Mahoning Pit Still Earth's Largest," you mention the Missabe Mountain mine lease from the State of Minnesota as expiring in 1933. The report of the State Auditor 1923-24 summarizes the various state leases. The Missabe Mountain mine was leased on March 2, 1892. All the early state leases were for a term of 50 years, which would make the expiration date in 1942 and would cut down materially the average tonnage to exhaustion, instead of the figure given, 6,000,000 tons. Thirty-five million tons was estimated as of May 1, 1927.

W. R. VAN SLYKE.

Eveleth, Minn.

Digest of Current Literature

Minerals of Kerguelen. Edgar Aubert de la Rue. *Comptes rendus de l'Academie des Sciences,* May 27. Pp. 1421-22. The Indian Ocean islands comprising the Kerguelen Archipelago are composed largely of enormous tabular basaltic columns. There are frequent alteration areas of these rocks, rich in zeolites and other siliceous minerals. These are interesting to the mineralogist, but have no economic value. There are, however, several large deposits of agate. The principal one is at Port Mary, on the eastern coast of Foch Island. Here the basalt rises to a height of over 1,600 ft. and in several places is covered with thousands of agates, many weighing several kilograms. Some are loose on the ground; others are still embedded partly or entirely in the basalt. The prevailing color bands are white, gray, yellow, and red. Smaller agate deposits are found in other parts of the islands. Commercial exploitation of these agates is believed possible. The only other mineral of economic value which has been found on these islands is Iceland spar. This occurs in veins in weathered basalt on Pigeon Point and on the Peninsula of Jeanne d'Arc, around Lake Daste. The deposits are not as extensive as those in Iceland, but the mineral is of excellent quality, clear and transparent. It is considered to be as important as the agates, in economic value to the colony. Most of the known volcanic rocks occur on these islands, but so far as is known these two minerals occurring in the basalts are the only ones worthy of exploitation.

Cobalt Spinels. G. Natta and L. Passerini. *Gazzetta Chimica Italiana,* April. Pp. 280-88. Hard crystalline minerals of the spinel type, containing bivalent cobalt, are described. These include cobaltous aluminate, chromite, ferrite and cobaltite. They have the composition CoM_2O_4, where the cobalt is bivalent and M stands for trivalent aluminum, iron, chromium, or cobalt. The minerals having these components are not all known in nature, but they are easily made artificially, for example, by heating cobaltous nitrate with the nitrate of the trivalent metal in the mol ratio 1:2. These artificial spinels, however, are isomorphous with the natural spinels, as shown by X-ray studies of their crystal lattice structures.

East Alpine Ores. A. Tornquist. *Metall und Erz,* second May number. Pp. 241-46. The complicated picture presented by the numerous ore deposits of the Eastern Alps is the product of several formation processes from different geological periods. Zoning, paragenesis and volcanic formations dating from various periods are included. The lead-zinc ores (containing copper and silver) of the Graz Mountains include apomagmatic deposits (Rabenstein-Haufenreith type) and perimagmatic deposits (Offberg type). There are two occurrences of siderite, of which the more recent seems to be older than the lead-zinc ores. A zone of perimagmatic antimonite and gold-bearing pyrites also occurs in the north and northeast of the region, and further south an ultra-apomatic mercury ore. A separate isolated deposit of lead-zinc ore occurs in the Gailtal Alps. It dates from the older Pliocene period, and is apparently not genetically related to the more recent gold ore found in the Hohen Tauern region. The picture of ore formation processes from the Upper Cretacean and Tertiary periods, as now known for the Eastern Alpine region, is very sketchy and much study is needed to fill in the gaps. A systematic study is urged of a large number of strata now unknown, especially of ore-bearing strata, and an outline is given of what is now known for various geological periods.

Specific Heats. W. A. Roth and W. Bertram. *Zeitschrift für Elektrochemie,* June. Pp. 297-308. Measurements have been made of the specific heats, over a wide temperature range, of several substances used in metallurgical processes. An improved all-metal calorimeter was developed for this kind of measurements. In it the heating medium is an aluminum block, which eliminates many of the difficulties encountered in the use of low-melting eutectic salt mixtures or other non-volatile liquids. A nickel-chromium wire was used to measure the higher temperatures, up to 1,000 deg. C. or more. For accuracy and ease of manipulation, the aluminum block was made with 37 of these thermo-elements, entering it from below. With this instrument, measurements were made of the specific heat of silica (various forms), calcium oxide, wollastonite, alumina, cryolite, sodium chloride, iron, hematite, magnetite, and fayalite. Heats of conversion were measured for the transitions: alpha to beta quartz, alpha to beta cryolite, and alpha to beta iron. Heats of fusion were determined for sodium chloride and cryolite. From the course of its specific heat changes, the rate of change of heat of formation of wollastonite with temperature was calculated. The temperature ranges in these experiments were from about 50 to 100 deg. C. up to 1,000 deg. C. or more, the highest being 1,098 deg. C., recorded in the cryolite measurements. Experimental results are given in tables.

Volatile Oxides. Feiser. *Metall und Erz,* first June number. Pp. 269-84. To ascertain the volatility of the oxides of lead, cadmium, zinc, and tin, a weight loss method was applied to measurement of the vapor or sublimation pressures, up to 1,200 deg. C. for lead and cadmium oxides and up to 1,500 deg. C. for zinc and stannic oxides. It was found that litharge becomes volatile at 750 deg., cadmium oxide at 900 deg., zinc oxide at 1,300 deg. and stannic oxide at 1,350 deg. C. Litharge boils at 1,472 deg.; cadmium oxide sublimes at 1,380-90 deg. In trials of the effect of relatively non-volatile oxides, it was found that the volatility of litharge is lessened by silica, ferric oxide, or stannic oxide. The very low volatility in presence of stannic oxide probably indicates compound formation between litharge and stannic oxide. The oxides of aluminum, calcium, magnesium, and zinc do not decrease the volatility of litharge. In connection with these experiments it was also found that the effect of sintering on the volatility of litharge is the result chiefly of the decrease in surface area. Trials were made with flue dusts from converters to find whether litharge could be separated from the other oxides by vaporization. It was possible to volatilize all the litharge; but even as little as 2 to 5 per cent of silica in the flue dust very considerably increased the difficulty of vaporizing the last traces of litharge. The experimental methods are described; curve charts are shown; and numerical data are tabulated.

Flotation and pH. D. Talmud. *Kolloid-Zeitschrift.* June, 1929. From the Frumkin theory of the influence of an electric field on adsorption, assuming at the boundary surfaces between a hydrophobic powder and a solution a potential difference whose magnitude is governed by the *pH* of the solution, it follows that the wetting power of oil for the powder (the floatability of the powder) is a maximum at a definite *pH* at which the potential difference is not far from zero. This was confirmed by experiment with sulphur powder and with powder from an electrode (99.5 per cent carbon). The flotation behavior of hydrophilic powders is much more complex. Experiments with such powders are in progress.

Slopes. K. Kegel. *Braunkohle,* June 15. Pp. 489-92. Landslides, cave-ins, and other failures of slopes in surface workings are discussed. These failures are the result of natural causes, such as undermining of the slope by water, clay slippage and so on; or to operating causes, such as excessive steepness of the slope or working too far in at the bottom. These causes are discussed, with emphasis on methods for stabilizing slopes and preventing slides, cave-ins, and the like. Due consideration must be given to the fact that wet clay is subject to flow, somewhat like glacial flow.

Fluorspar—The Kentucky Geological Survey, Frankfort, Ky., has recently issued a new map of Crittenden County, Ky., which is said by W. R. Jillson, State Geologist, to be the first accurate map of the district that has appeared. The area includes the important fluorspar mining region of western Kentucky. On the map are shown not only the mines but the structural and areal geology of the district (including the fault pattern). A regional stratigraphic section is given. The work has been done by Stuart Weller and A. H. Sutton. It is correct to Jan. 1, 1929.

Fused Salt Electrolysis. H. Moritz. *Metall und Erz,* second May number. Pp. 246-47. An equation is given for the heat balance in the type of fused salt electrolysis in which irreversible losses in current yield are encountered. The equation expresses the exothermic nature of the reaction of anode gases with metal mists. From it, the conditions which must be met by a furnace for such a process are shown, and suggestions are given for constructional features to meet these conditions and permit the most economical operation of the electrolysis.

Strategic Raw Materials. R. Taylor. *Metals & Alloys,* July, 1929. Among strategic raw materials are discussed antimony, chromium, iodine, manganese, mica, nickel, nitrate, platinum, quicksilver, tin, tungsten. The author, who is a major in the Ordnance Department of the United States Army, analyzes the situation in respect to each, with particular regard to national requirements in the event of war.

MINE, SHOP, AND PLANT

INTERPRETING TO THE OPERATOR THE SERVICE AND POLICIES OF THE MANUFACTURER, AND TO THE MANUFACTURER THE PRACTICE AND NEEDS OF THE OPERATOR

Dust— Outside and In

TWENTY years ago the ground adjoining a certain large concentrator was a flat green expanse, sunflower-covered in early spring and in general pleasing to the eye the greater part of the year. At one edge of it the mill had started to discharge its tailing. Since then tonnage has increased steadily, and today the place presents a very

Sheikh Ali ben Ali has wandered away from the circus and finds himself on the edge of an extensive tailing dump just as the wind is blowing. The sharp, familiar sting of the sand reminds him of his home in the Arabian desert.

different aspect. The green is gone, lost beneath millions of tons of sand—a waste that stretches in some directions as far as the eye can see. This, though offending the esthetic sense, would cause little comment by those whose minds are bent on the practical business of getting copper out of ore, were it not for the wind. When the latter blows, as it does too frequently, the fine sand, whipped from the surface, gets into the eyes, nose, and mouth of everyone without distinction, especially of those forced by circumstances to live near by. These dust storms are disagreeable, even painful, if no way of escape presents itself, and will put an unprotected person out of action, so far as action depends on ability to see.

What can be done to remedy such a condition? Once the answer might have been to "grin and bear it," or perhaps to "pray for rain." But times have changed, and more regard is shown by industry for the comfort of workers and the communities in which they live. Goggles—of the motor-car variety—would help. The writer wished he had a pair when recently the wind staged a miniature Sahara sand storm, to his discomfort. Respirators to filter out the dust would also be welcome to a person forced to work outside under such conditions. No practical way of removing the cause of the trouble can readily be seen. To attempt to keep moist the surface of such a dump (and in such a dry climate) would be on a par with trying to stop the wind. Covering with soil and planting grass is as impracticable as it sounds. The humorist might suggest coarser crushing to make the grains too large for an ordinary wind to carry, but the metallurgist would object. Discharge of the tailing into a large near-by lake would take care of the current output for a time but leave unsolved the problem of the dump already in existence.

These things being so, the local citizens will probably have to take dust—some of it—as their portion, perhaps eat it at times, mindful that eventually they will return to it, and get along until then as best they can with goggles and even respirators. Some local Beau Brummel is all that is needed to start the fashion.

Within the Walls

So much for an extreme case of dustiness outside a mill. But what of dust inside? Some plants show an atmosphere that is free of dust. Possibly the operator is merely lucky—the ore may be damp and the process wet, so that a workman would have difficulty in raising dust. In some operations, though, the company has deliberately spent money to bring about this condition. A dozen or more operators in the metal-mining field can be pointed out who have installed dust-removal systems (not to be confused with electrical precipitation apparatus). Outstanding among them are the large copper companies of the Southwest (*E.&M.J.*, June 2, 1928, p. 887) and a few other Western operators; an important zinc company in the East; and two Canadian gold mines.

But many companies seem never to have heard of equipment and practice of this sort. Crushing, in particular, and possibly other steps of the work, are attended in their plants by the production of dust—sometimes just enough to make a haze; at other times so much that one can scarcely see a man because of it. Such conditions are surprising, when found, because of the high plane of efficiency that milling operations in general have attained.

In some mills where dust-collecting installations have been made, consultants outside of the mining company's organization have been employed to design and install the system. In others the operator's own engineering staff has attacked and solved the problem.

As practiced in the plants that have adopted it, dust collection (aside from electric precipitation), in its general features, involves the housing of the machine or the place where the dust originates and the removal of the dust by fans or blowers and subsequent discharge through ducts either at a point outside the mill where the dust will do no harm or to some receptacle where it is caught, such as settling chambers, filters, cyclones, or tanks of water.

Success and Failure

Care must be taken in installing such a system. In some installations the system has failed to work. As to this, one consulting engineer, who has been successful as a designer and builder of such systems, declares that the task is more than a tinsmith's job (*E.&M.J.*, Oct. 20, 1928, p. 627). It calls for more than building a housing and a duct with a fan inserted in it. Engineering principles are involved. He stresses three practical points: (1) The dust should be caught before escaping into the mill air and as near as possible to the places where it is formed—this either with the aid of hoods or housings or without them. (2) Use of a number of small units is advisable to avoid carrying the dusty air long distances. (3) In discharging the air through filters a great area of filtering surface is desirable to prevent clogging. Neglect to consider these points may result in failure of the system.

Dust collecting is not a new art, that the mill man should hesitate to employ it. A well-known maker of blowers states

This queer looking creature is not from another planet but is merely a mill man who is trying to adapt himself to a dusty environment.

that he has a list of some 300 names of contractors who design dust-removal systems, which gives some idea of the extent of the practice. In many industrial plants it has long been the custom to remove by pneumatic means the dust or fine cuttings or shavings of materials used in operation, in order to prevent waste, or pollution of the air, or clogging of the machine. Investiga-

tion in these other fields will show the curious mill operator much to interest him.

Bad conditions as to dust may do more than invite correction—they may provoke annoying legislation. Where found, they offer opportunity to the anti-dust crusading salesman. Corrective legislation, always a possibility, would put an even more persuasive argument in the latter's mouth. This much is certain: if the dust were intrinsically valuable, steps to collect it would be taken, its yield helping to defray the cost. Health and comfort of employees and the protection of equipment against undue abrasion undeniably have their value also.

Further Points on Lubricants

NUMEROUS tests, chemical and mechanical, have been devised for determining the qualities of a lubricant. In general they require special apparatus, as well as special training of the person making them. Some large mining companies, well provided with laboratory facilities, sample and test every shipment of lubricants received. In this way they are able to reject a consignment without delay if it fails to meet specifications, a desirable consideration where oil may be received in tank-car loads. The average company, however, finds it impossible or inconvenient to do this and must depend on the results it gets in actual operation to know whether its lubricants are satisfactory. This is hardly a misfortune, for, after all, the only reliable way of testing lubricants is to use them and to watch and record the results.

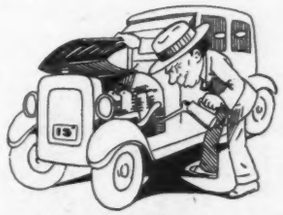
Buying of lubricants is done to a large extent on specifications, despite the fact that sampling and testing are not widely practiced. This simply means that specifications covering the characteristics of a lubricant are furnished if requested by the seller. If, uopn using a certain oil or grease, the purchaser finds that it acts differently from that previously supplied, and is unsatisfactory on this account, he can have it tested and checked against the specifications.

A Controversy

Opinion as to the value of specifications varies. Incidentally, the controversy is an old one and not confined to lubrication. Much could be written on the subject. One long-established manufacturer of certain brands of lubricants is well known for his attempts to discredit the use of specifications in buying. A certain mining operator, typical of others, says that he has little use for them, his argument being that "you can get a satisfactory oil and one that is unsatisfactory, both of which will be covered by the same specifications. The government buys on specifications and as a result gets stuck with a lot of poor supplies."

Specifications may of course be so loosely drawn as to permit this. Besides, it is not always easy or possible to express the desirable qualities of a lubricant in terms of them. One of the most important of these qualities is oiliness, by virtue of which a lubricant sticks to metal surfaces. No way of measuring oiliness directly has been devised, inasmuch as it bears no known relation to the physical properties of the lubricant. Two oils may have the same viscosity, yet be of different oiliness.

However, specifications are not to be scoffed at. If carefully drawn to cover the points that are thought to govern performance, they should furnish a useful check. Where commercial and technical considerations conflict, such specifications will represent a nice balance between them.



The best test of a lubricant is found in using it. Bill is trying some of the new compressor oil on the family bus. Conditions aren't exactly the same but they're close enough, he thinks.

The mining company that ordinarily neither samples nor makes laboratory tests on its lubricants—and companies of this type are in the great majority—will find specifications advantageous only when something happens. Then if the lubricant be found at fault, the specifications will furnish a firm basis for a claim against the company that has been supplying it.

Where sampling and testing are the rule, however, specifications help in buying. The chief engineer of an important Western plant says they make it possible to eliminate improperly refined products at the start. Indeed, his specifications stipulate that a lubricant must be bought from a company having ample refining facilities as well as a laboratory for making the tests that he requires. Some small refineries are not thus well equipped. He believes that the big refining companies are quite dependable. Competition is so keen that they naturally want to turn out high-grade products. Incidentally, lubricants are checked at his plant not only on receipt but monthly thereafter to guard against deterioration. A Kansas operator says that as competition is keen he can depend on the oil companies to give his problems serious consideration.

In fine, specifications may be exceedingly useful. Results obtained under working conditions, however, are the final criterion of the practical value of a lubricant.

Why Sample?

When an oil salesman is called in or volunteers to improve a company's lubricating practice he not uncommonly takes samples of the lubricants in use. Naturally, he wishes to know their nature and has his laboratory analyze the samples. The purpose underlying such practice at times may be simply to copy and supply the lubricant at a lower price, or else to furnish a cheaper substitute, which may or may not be to the advantage of the mining company. One well-known authority on lubrication maintains that a capable lubrication engineer should not find it necessary to sample the lubricants in use to be able to recommend the proper lubricants. But, inasmuch as the best test is in actual operation, a knowledge of those previously used, together with the results obtained, should be helpful in determining what improvements can be made.

Common Sense

Ideally, every machine, be it underground or on the surface, should have the lubricant best suited to the conditions under which it operates. Practically, this would mean too many lubricants—"enough to stock a drug store," as one operator who had suffered from too varied an assortment put it. "Simplification of practice" in this respect will be found advantageous but must not be pushed too far. A copper company that gives selection close attention used to carry two or three kinds of lubricants for each lubricating job. Now, however, it is simplifying and keeping the number down. Not only does this lessen the work of storage and distribution, but it permits the purchase of individual lubricants in larger quantities. Occasionally it may mean the use on a certain machine of a lubricant that is possibly a little too good for that machine (although one operator has stated that, rather than add to the number of lubricants stocked, he would use a lubricant slightly inferior to that required). But by tracing the matter back to the purchasing office, a saving may be disclosed. Furthermore, the fewer the kinds of oil or grease there are about a mine or mill, the less is the chance that the wrong lubricant may be used on some machine, with resultant damage to it.

Practical vs. Ideal

All this, of course, means simply that in selecting lubricants a company must strike a balance between the practical and the ideal. If an error be made, it should be in providing for a certain purpose a lubricant that is better than actually needed rather than one not good enough; otherwise, resultant damage to the machine may cost far more than the saving made in buying and in simplifying the procedure. A. H. H.

See *E.&M.J.*, July 6, 1929, pp. 20-21; also Aug. 3, pp. 182-183.

Personal Notes

M. H. Guise is making a tour of Canadian mining camps.

J. P. Bickell, president of McIntyre-Porcupine, has been inspecting the company's property.

F. C. Lincoln, professor of mining at the South Dakota School of Mines, is examining properties in Montana and Washington.

J. Errington has returned to Toronto from a four-week trip to British Columbia in connection with the affairs of Sudbury Basin.

James M. Hill, mining engineer, of Berkeley, Calif., has completed an investigation of non-metallic minerals in Siskiyou County, Calif.

I. J. A. Diamond, consulting mining engineer, has moved his offices to the Transvaal Buildings, Johannesburg, Transvaal, South Africa.

John I. Ballard, mining engineer, with Chile Exploration, at Chuquicamata, Chile, is in the United States, visiting several Western mining districts.

J. J. Walker, of South 3307 Tekoa St., Spokane, Wash., requests the address of Joe Walker, formerly with the Shattuck Denn Mining Company, Bisbee, Ariz.

Lloyd C. White, metallurgical engineer, of San Francisco, has returned from a three-week trip in central Idaho in the interest of Yellow Pine Mining.

J. Cleveland Jones is in charge of the work of the Compañia Inversiones del Oro, in the absence of the general manager, **Geoffry M. Wasteneys,** in London.

John T. Joyce, Colorado State Commissioner of Mines, was elected vice-chairman of the new state geological survey board, at its meeting of Aug. 7.

Scott Turner, director of the U. S. Bureau of Mines, has recovered sufficiently from a long and serious illness to enable him to spend a few hours each day at the bureau.

C. W. Newton, director and general manager of the Callahan Zinc-Lead Company, has left Wallace, Idaho, on a two-week business trip through the mining districts of California.

A. A. Boyd, a member of the Australian mining commission, and an official of the Mount Morgan corporation, was recently in Salt Lake for a few days, studying Utah operating methods.

H. W. Howe, of the staff of James and Gill, geologists, of Montreal, has been appointed by Obalski-Chibougamou Mining, as resident geologist of its properties in the Chibougamou district.

Keith Allen, mining engineer for Rhodesian Broken Hill Development, arrived in New York on Aug. 11. He will spend about six months in the United States, studying mining methods at various camps.

J. B. Tyrrell, of Toronto, has resigned as vice-president of Northern Canadian Mining, to devote more of his time to the affairs of Kirkland Lake Gold Mining, of which he is vice-president and managing director.

Alan Kissock, who invented the process of alloying molybdenum with steel by the use of calcium molybdate, has just been elected vice-president in charge of production of the Climax Molybdenum Company. Most molybdenum steel is now made by his process. Mr. Kissock graduated from the Colorado School of Mines in 1912, with the degree of mining engineer and for three years thereafter engaged in mining examination and management. From 1915 to 1918 he was manager of the Molybdenum Products Company, of Tucson, Ariz., and then became president of the Steel Alloys Company, of Los Angeles, where he remained until 1922. The next two years he devoted to mine management and examination and then he became connected with the Climax Molybdenum Company. Since 1924 he has been active in mining and milling and the construction of plants for the production of calcium molybdate, as well as promotion work in connection with the use of molybdenum steels in the mining and other industries.

ALAN KISSOCK

A. B. Young, assistant manager of the International Smelting Company, was in Los Angeles recently for a short stay. **B. L. Sackett,** general superintendent of the company, has returned from a tour of the Northwest.

Cecil Fitch, general manager of the Chief Consolidated Mining Company, has returned to Eureka, Utah, from a vacation trip to Arizona. **J. F. Johnson,** general superintendent at Eureka, visited Butte and the Coeur d'Alene district recently.

A. G. McGregor arrived in New York on Aug. 16. Accompanied by **Dr. Otto Sussman** and **H. M. Burkey,** of the American Metal staff, he will visit several Western plants to secure details of the latest developments of practice for incorporation into the Roan Antelope flow sheet.

Julian Boyd, mining engineer, of Los Angeles, is making an examination of a gold dredging property near the Yukon River, Alaska. He expects to return to Los Angeles by Sept. 20. In order to make this rapid trip, Mr. Boyd will have had to fly from Fairbanks to the Yukon and back.

Dr. **H. C. Parmelee,** of New York, editorial director of the McGraw-Hill Publishing Company and secretary of the American Institute of Chemical Engineers, delivered a lecture on Aug. 10 before the Institute of Public Affairs at the University of Virginia. His topic was, "Growth of the Chemical Industry in the South."

Among the official delegates to the World Engineering Congress in Tokio this fall, the following will represent the A.I.M.E.: **H. F. Bain, G. D. Barron, F. W. Bradley, J. V. N. Dorr, B. E. Eldred, J. R. Freeman, H. D. Hibbard, J. C. Hoyt, C. K. Leith, P. M. Lincoln, F. F. Lucas, C. W. Merrill, M. L. Requa, J. V. W. Reynders, R. H. Richards, G. O. Smith,** and **W. Y. Westervelt.**

John A. Burgess, mining engineer, has been appointed consulting engineer for Mayflower Associates, Inc. Although he will retain his office in San Francisco, his headquarters will be in New York. Mr. Burgess has been connected with the Mudd-Wiseman interests of Los Angeles, who control Mayflower Associates, continuously since he took charge of the United Eastern mine, at Oatman, Ariz., soon after the start of the Oatman boom, although he has been employed by various companies as consulting geologist and engineer.

Robert E. Talley, general manager of the United Verde Copper Company, at Jerome, Ariz., announces the following changes in the staff: **W. V. DeCamp,** formerly general mine superintendent, has been promoted to the position of assistant general manager, with offices at Jerome and Clarkdale; **W. W. Lynch,** who was mine superintendent, is now general mine superintendent, at Jerome; **T. W. Quayle,** formerly general mine foreman, has been promoted to the position of mine superintendent, at Jerome; and **C. E. Mills,** chief engineer, is now assistant mine superintendent and chief mine engineer, at Jerome.

OBITUARY

Glenn McDonald, well known in the Coeur d'Alene district, died recently, in Wallace, after an illness of about a month. Mr. McDonald, who was 86 years old, was one of the pioneer prospectors in Nine Mile Canyon.

Dr. **Horace Bushnell Patton** died on July 15, 1929, at Atascadero, Calif. Dr. Patton is best known by his long connection with the Colorado School of Mines, where he was professor of geology and mineralogy from 1893 to 1917. He graduated from Amherst and took his doctor's degree at Heidelberg in 1887. He was assistant professor at Rutgers, 1888-1890; assistant geologist on the Michigan Geological Survey, and instructor at the Michigan College of Mines. On leaving the Colorado School of Mines he engaged in professional work and had been associated with several petroleum companies. He was held in high esteem by his former students.

Latest Developments in the Copper Fields of South Central Africa

Special to *Engineering and Mining Journal* from

OWEN D. LETCHER

JOHANNESBURG, July 8, 1929—On returning to Johannesburg from a journey through Northern Rhodesia, the Belgian Congo, and Angola, in the course of which I visited mines and plants in Katanga and on the British side of the Congo-Zambesi watershed, I find that so great an amount of data has been accumulated, and so many impressions have been formed, that it is difficult to know where to begin in an endeavor to place before readers of *Engineering and Mining Journal* a crisp picture of the position and prospects, in so far as at present ascertainable, of the great copper field of South Central Africa now engaging so much attention throughout the world.

Although the region is producing at the rate of about 140,000 tons of copper per annum, of which the Union Minière, in Katanga, is contributing 96 per cent, the probabilities are that within the next seven or eight years the whole region will be producing 500,000 tons or even more of metal per year—an event which is bound to have not only important repercussions on South and Central Africa, but is certain also to have influences of momentous nature upon the copper industry of the whole world. And, moreover, the more one looks into this complex picture of copper developments in what we, in South Africa, term "the Far North," the more does one become imbued with the idea that the tendency must be toward a fusion of interests or at least some comprehensive working agreement which will protect and exploit to the fullest advantage the common interest of all.

THE TWO BIG GROUPS

In so far as Northern Rhodesia alone is concerned, there are two big main forces at work—namely, what one might term the American group (the Rhodesian Selection Trust, with Mr. Chester Beatty and his general representative in Northern Rhodesia, Mr. Nicholaus, standing in the forefront of the battle, and behind him some of the most powerful metal magnates of the United States), and another big group, represented by The Rhodesian Anglo-American, associated with the Chartered Company, the Anglo-American Corporation, the Johannesburg Consolidated Investment Company, the Bechuanaland Exploration group, Rio Tinto, and Union Corporation. On this side are Sir Ernest Oppenheimer, Mr. Solly Joel, Sir Edmund Davis, the members of the Chartered Company's board, and others. Some of these are not only vitally interested in the Northern Rhodesian base-metal industries, but, in addition, they have millions at stake in the Rhodesian Railway, in the Port of Beira, in the Wankie Colliery, and in Northern and Southern Rhodesia generally. The Rhodesian Selection Trust group has no such complex holding or association, and yet the interests of the two big groups, as represented by directors, dovetail and overlap to a rather remarkable degree.

But, generally speaking, it seems fairly clear that the Selection Trust is concerned wholly with the development of the astonishingly large and rich copper deposits which it has secured in the N'Kana Concession, and is not concerned with the operations of the Rhodesian Railways or of the Wankie Colliery, except as these are essential for the production and marketing of copper.

TRANSPORTATION SYSTEMS

Under the circumstances, therefore, it is not surprising to find that a third group represented by Sir Robert Williams, of the Tanganyika Concessions and the Zambesi Exploring Company, with the rich Kansanshi mine, the Luano coal fields, and control of the Benguela Railway, should appear in this intricate picture as a factor of very great importance. The heart of the Northern Rhodesia copper fields is approximately the same distance from Beira by rail as it is from Lobito Bay over the route now being constructed, but in favor of the West Coast route it must be urged that the ocean terminus of the Benguela Railway is nearly three thousand nautical miles nearer England and the big refineries on the eastern seaboard of the United States. In Southern Africa, with its sparse industrial development, railway rates are notably high, and the length of land freightage is, therefore, a much more material consideration than sea transportation charges. All the same, sea freight must obviously be a substantial consideration, and therefore Lobito Bay's geographical situation must be favorably considered.

Those mines which are under the control of what may be termed the non-American group will, for various reasons, almost certainly export and import through Beira. With the American-controlled or Rhodesian Selection Trust concerns, however, there can be little doubt that marketing copper via Lobito Bay makes a strong appeal.

Summary of Other News of the Week

PHELPS DODGE Corporation has discontinued operations at Sacramento pit, in the Warren district of Arizona. Page 265.

* * *

Construction of the spur line of the Canadian National Railways to the Amulet mine, in the Rouyn district of Quebec, will begin immediately. A contract has been given for the 300-ton concentrator. Diamond drilling confirms discovery of high-grade orebody. Page 264.

* * *

A strike on the Tarbaby property has stimulated activity in the Big Cottonwood district of Utah. Howell and Price properties are also pushing development. Page 266.

* * *

Wright-Hargreaves has opened a new orebody in the east crosscut of the 500 level of its mine, in the Kirkland Lake district of northern Ontario. Page 266.

* * *

Magma Copper has made preparations to resume depth development in its mine, in the Superior district of Arizona, which was halted twenty months ago because of fire. Page 265.

* * *

The Mexican Congress has passed amendments to the Constitution making it possible to enact the new labor law as proposed. Modification of the bill is probable. Page 267.

No real land mileage advantage would be obtained by using the Belgian Congo and Benguela railways by way of Elisabethville, Tshilonge, Dilolo, and right across the breadth of Angola. But if a line were carried out from the Northern Rhodesian copper fields through N'Changa and Kansanshi to link up with the Benguela railways in Angola, the haul from, say, N'Dola to Lobito Bay might be reduced to approximately 1,100 miles, as compared with 1,450 miles from N'Dola to Beira. The possibility of such a route eventually being available gives rise to numerous interesting speculations.

Sir Robert Williams and his associates constructed the Benguela railway line primarily to serve the copper fields of the Union Minière du Haut-Katanga, in which Sir Robert Williams and his holding company, Tanganyika Concessions, is largely interested. But it is likely to be many years before the Benguela line will have its carrying capacity severely taxed, and, therefore, the linking up of the Northern Rhodesian mines as well as those of the Congo with the Benguela Railway would presumably be whole-heartedly aided and encouraged by the owners of the line.

In Katanga the control is not so complex as in Northern Rhodesia. The copper region is owned and administered by the Union Minière du Haut-Katanga, in which Sir Robert Williams' Tanganyika Concessions has a 30 per cent interest.

It has been the policy of the astute Belgian and British financiers who control and direct this enterprise to secure solution of the transportation problem by securing railway communication with both the Atlantic and Indian Ocean seaboards, while, at the same time, the development and equipment of their vast and rich mineral concession is proceeded with.

Four routes are now either completed or are in course of completion—namely, the Rhodesian Railways route to Beira, the East Coast route with an exit at Dar-Es-Salaam, the Bas Congo route to the mouth of the Congo, and the Benguela Railway, with an exit at Lobito Bay.

Merger of Interests Possible

The relative advantages, distances by rail and sea to markets, and freight rates of these various routes make a problem of great intricacy and complication, to which reference has been made in previous issues of *E.&M.J.* One very essential point to bear in mind is that the coal fields at Wankie along the line of the railways which supply coal and coke to the copper mines, plants, smelters, and railways will tend in some degree to anchor the copper producers on both the British and Belgian fields to the Rhodesian railways and to the port of Beira for many years to come.

It is this dependence upon Wankie, which may, to a large degree, become a powerful factor in bringing about a fusion of all interests in this great

H. F. Chaves
Manager of the Benguela Railway. Mr. Chaves is a mechanical engineer.

copper field. But in addition to this consideration of fuel there are difficult problems connected with native labor, the pooling of transportation resources, the shipment and marketing of products, and the development of rich copper deposits occurring right on the Belgian-British frontier. All of these will be far more effectively handled if they are tackled on broad comprehensive co-operative lines. And it is for these and other reasons—financial considerations, for example, must play an important part—that it is suggested that sooner or later the mining world may witness one of the greatest of fusions that has ever been achieved in its history: that is to say, a merger of all copper mines and plants under one huge control both in Northern Rhodesia and in the Katanga Province of the Belgian Congo.

The Opening of the Benguela Railway

One of the main objectives of my recent transcontinental journeying was to attend the official opening of the Benguela Railway at Luao, on the Congo-Angola border, which event took place on June 10 last. This ceremony was performed by the Portuguese Minister of the Colonies in the presence of a distinguished gathering including H.R.H. Prince Arthur of Connaught, the High Commissioner of Angola, the Governor of Katanga, and Sir Robert and Lady Williams.

The Benguela Railway was launched as a vast adventure. Probably no line ever built in the history of the world has been constructed to reach so far distant an object as this. From Lobito to the Angola-Congo frontier is 1,347 kilometers, and a further 526 kilometers remain to be constructed in order to complete the link between the Belgian Congo railway system at Tschilongo and the inland terminal of the Benguela line. Construction of this is now proceeding. The earthworks have been built for a distance of 150 kilometers and the rails have been laid for 50 kilometers. Recent progress has been at the rate of 1¼ kilometers per day. Delays have been occasioned by scarcity of native labor and shortage of locomotives. But I learned from Monsieur O. Jadot, manager of the Congo railroad system, that matters have recently improved materially both in regard to natives and locomotives, and that the new line will be completed by July, 1931, to Tshilongo, which is about 50 miles north of Panda, the center of the Katanga copper belt. When this is completed there will be through railway communication right across the African continent from Benguela and Lobito Bay, on the Atlantic, to Beira, on the Indian Ocean.

Copper Production by the Union Minière

This year's output of copper by Union Minière will probably be in the neighborhood of 130,000 tons. Production for 1928 was 112,500 tons, and for 1927, 88,000 tons.

The most important event that has taken place in the history of Union Minière for many months past has been the starting up of a section of the first unit of the new leaching plant at Chituru Hill (Panda). In the first instance work will be more in the nature of an experimental run than anything else, but it is highly important to note that the first unit of the immense plant, upon which engineers have been busy for the past three years, is now virtually completed and in due course will add its quota to the expanding output of Union Minière.

Current is at present being obtained from the Panda steam turbines, but heavy machinery for the hydro-electric plant on the Lufira River is now passing through Elisabethville, and in due course electricity generated from the Lufira Falls will be employed for electrolytic precipitation.

It is clear, therefore, that output is increasing, and from now onward there is likely to be some steady augmentation of returns until recent extensions of and additions to plants are completed and in full running order, which will secure to the company an output of from 150,000 to 160,000 tons per annum. Thereafter production may remain constant, so far as one can see, until a further policy of expansion embracing the addition of another unit, and possibly two units, each of 30,000 tons' capacity, to the Chituru leaching plant is put into effect.

Over and above this is the question of what additional plant may be erected to serve the Musonoi or western group of mines. It seems fairly reasonable to assume that a separate treatment and production plant will be installed at Musonoi, which is situated on the prolongation of the Benguela Railway into the Congo.

The situation at present prevailing on the Northern Rhodesian copper belt is one of intense interest and the outlook is of magnificent promise.

This field, although it does not afford prospects of being as high-grade a copper field as that which is controlled by Union Minière in Katanga, will, nevertheless, probably prove to be capable of producing a bigger tonnage

Catumbela Bridge

A fine piece of engineering work between Lobito Bay and Benguela.

than the famous copper belt of the Congo. Moreover, its sulphide ores respond more rapidly to simple and economic treatment than the oxidized beds of Katanga. A further important consideration is that the big copper belt of Northern Rhodesia is more concentrated in character than are the occurrences in Katanga.

The differences between the Congo and Northern Rhodesian ores are significant. Most of the potentially big copper mines which are now being developed in this territory were known for some years prior to 1923, but it was not until then that any whole-hearted effort was made to develop them. The chief explanation of the desultory interest shown in these occurrences lay in failure to realize that in their difference from the Congo deposits lies their strength. So long as large reserves of "oxide" ores, much of which averaged 15 per cent copper, were available in the Congo, Rhodesian "oxide" ores averaging 3 to 5 per cent copped did not appear particularly attractive.

The lack of enthusiasm evinced for these "low-grade" occurrences was not combated by the fact that 6 to 7 per cent "oxides" in the Congo were discarded as being too poor to treat by the then existing methods. Experience there showed that the Katanga orebodies did not alter to minable secondary sulphides at depth, but changed very suddenly into extremely lean primary ore of no value. It was assumed that the Rhodesian orebodies would display the same characteristics and that here, as in the Congo, the ore above water level was representative of the orebody as a whole. This reasoning overlooked the fact that the Congo orebodies occur in siliceous rocks, under alkaline conditions, which oppose the development of secondary copper sulphides. The Rhodesian ores, on the other hand, occur in siliceous rocks under acid conditions, which are in every way ideal for the carrying on of the secondary enrichment process. Though technical opinion on this point is not unanimous, the evidence indicates that this process has taken place and that the remarkably uniform and extensive sulphide orebodies of Northern Rhodesia, averaging 3 to 6 per cent copper, and more, are secondary enrichment deposits. The depth, uniformity, and lateral extent over which these processes of ore deposition have occurred are without parallel in the world's known copper deposits. Nevertheless, they would not have remained so long undeveloped but for the fact that their surface showings (insignificant as compared with those of the Congo) did not appear to warrant the expenditure involved in sinking below water level. And so for many years such sporadic attempts as were made to exploit these properties were confined largely to the further search for "oxide" copper ores of a grade comparable with those of the Congo. Even the first few drill holes put down were so unfortunate as to indicate low values of mixed "oxide-sulphide" ores below the present water level, and so it is that only within the last two or three years has the true significance of these deposits begun to be realized.

In this area six big mines are now being developed and numerous encouraging prospects are being explored. One mine, the Roan Antelope, is being equipped on a treatment basis of 6,000 tons per day, with provision for duplication of plant, and one other—N'Kana—is likely to have equipment of similar size working within the next few years. The four others will also be equipped for large-scale production, and various other mines at present undergoing exploration will also become big producers.

It is indeed probable that by 1934 this field will be producing 200,000 tons of copper metal per year. In preparation for this, immense sums of money are being expended, diamond drills are busy exploring the subterranean riches of the copper field, great quantities of machinery are being purchased and installed, and railway lines are being built.

Roan Antelope's Big Program

Apart from the old Bwana M'Kubwa property, the most advanced copper mine in Northern Rhodesia from the points of view of development and equipment is the Roan Antelope. The scene of bustling activity to be observed there almost beggars description. If any interested persons have any doubts regarding the magnitude of Northern Rhodesia's copper industry they should proceed to the Roan Antelope mine and see for themselves what is in progress—a huge mining township in the making, the preliminary portion of a superplant in course of erection, engineers and mechanics poring over plans and diagrams, motor cars and lorries rushing here, there and everywhere; natives by the hundred in smart khaki uniforms; pipes and rails and material of all kinds piled up for erection; and massive pieces of machinery awaiting their turn to be fitted into the colossal machine which is to turn out copper at the rate of nearly two hundred tons of metal per day.

Any visitors to the Roan must rapidly come to one of two conclusions: either that the stuff must be there or else that a number of millionaires have gone stark, staring mad. For money is being literally poured out at the Roan. The huge warehouse which will contain spares and supplies of every type and kind is rapidly approaching completion, and a high timber headframe is going up above the main shaft. This is a sinking headgear and later on will be supplanted by a permanent steel headgear.

Work is well advanced in connection with the shops and railway lines. At the power house a 1,000-kw. unit is in operation, and two other units, each of 7,000 kw. capacity, are to be installed. One of these sets is due for delivery in October and the other in March of next year. Two Bellis & Morcom compressors, each of 3,000 cu.ft. air capacity, are installed. The concentrator plant will be of 6,000 tons' capacity per day, with provision for extension to 12,000 tons per day. Railroad lines are being put down wholesale, to facilitate the erection of the big plant, and labor-saving devices of every type, such as cranes and conveyor belts, are being installed in every shop, store, and warehouse. A water supply for the Luanshya Township is being insured by the provision of two storage tanks, each of 500,000 gallons' capacity. Water will be pumped from the Kufubu River, 6 miles distant, by electric pumps.

Whether the Roan Antelope will eventually prove itself to be the biggest copper mine in Northern Rhodesia, or whether it will eventually rank second in point of output to N'Kana or possibly some other mine, remains to be seen. One thing is, however, very certain: the Roan, with Roan Extension and Muliashi, will be one of the largest producers of copper in the world. And it is also assured that the Roan—by virtue of its comparatively advanced position as regards development and equipment—will reach the stage of large

production sooner than any of the other mines of Northern Rhodesia's copper belt.

When one comes down to figures concerning tonnages and outputs at the Roan, as in the data concerning other Northern Rhodesia copper mines, one very soon becomes involved in figures which, as Major Tudor Trevor, late Secretary for Mines in Northern Rhodesia, has aptly said, are of astronomical proportions. In the last twelve months the known tonnage of the Roan Antelope orebody and of its extensions toward Muliashi has increased immeasurably, and in the Roan Extension-Muliashi sector the width of the cupriferous beds can only be described as enormous. Production plans and the capacity of the plant about to be installed and contemplated have, therefore, been framed to keep pace with this increased productive potentiality. The size of the plant upon which Mr. Marcellus and his constructional engineers are now engaged is based upon a daily handling of 6,000 tons. Assuming that this equipment is in continual operation and estimating recovery at 60 lb. per ton treated, this would give a yearly output of 65,700 tons of metal. With the price of copper at £75 per ton, a total of £4,927,500—or not far short of five million pounds sterling—is arrived at.

Roan's Possible Earnings

The equipment is, however, being designed with a view to duplication. Provision has been made for the eventual installation of a concentrator plant which is to handle 12,000 tons of ore per day, and if this is carried out—

A 600-ton train hauled by a Garratt locomotive

This is the smallest goods train on the Benguela Railway. The largest is of 1,300 tons.

as it well may be—the Roan's copper output will have a value of approximately ten million pounds sterling per annum. By comparison with such figures as these, even the returns of Government Areas—the pride of the Rand—sink into a place of relatively minor importance, and if we assume the cost of producing and marketing copper at £30 per ton, it becomes abundantly evident that the profits earned are likely to be of such magnitude that the present premium for Roan shares is justified by dividend prospects.

The Roan is admittedly one of the largest of the Northern Rhodesia copper mines, but it is, all the same, only one of a half dozen properties situated in the copper belt of this territory which are likely within the next few years to take rank among the great copper producers of the world.

N'Kana and Mufulira

There is, for example, the great N'Kana mine of the Bwana M'Kubwa company, about 50 miles to the west of Bwana. Good progress is being made with the construction of the N'Kana branch line from N'Dola. The rails have now been laid for a distance of approximately 15 miles from N'Dola, and the earthworks have been built almost on to the Kafue River. At N'Kana itself the power plant is rapidly approaching completion, and the pilot plant should be in operation before the end of the year. N'Kana has today proved itself to be a higher-grade proposition than the Roan, and he would be a bold man who would at this juncture assert which is eventually likely to prove to contain the larger tonnage. One can in any case quite definitely assert that N'Kana will rival the Roan as a copper producer. It will probably operate on a similar basis of ore handling, and, by virtue of its higher grade, it may indeed eclipse in output that of the great Selection Trust producer.

And then there is Mufulira, and the very promising occurrence recently located at Mokambo, right on the Congo border, which is also under Rhodesian Selection Trust control. Whenever the relative merits of Northern Rhodesia copper mines are discussed nowadays, the savants always look extremely knowing and mutter the magic word "Mufulira"! The general view is that it is the richest of all, and such figures as have been published with regard to development and drilling certainly indicate that this opinion is based on fact. As to size, it is far too early yet to venture any opinions as to how large a property Mufulira may be, but it is already assured that it will be a large one, and here again one quickly comes into the spectacular figures when attempting to assess its future output.

Mufulira is only a few miles from the Congo border, and a branch line from Mufulira to Mokambo station, on the Katanga railroad, is being constructed. This line will be 12 miles in length and its object will be to facilitate development and construction and later on to enable concentrates from Mufulira to be railed through N'Dola to the big smelter to be installed at the Roan.

On the question of smelters and smelting policy much might be written. Originally there was a suggestion that one large communal smelter should be erected for the purpose of smelting the concentrates of all mines in the N'Kana Concession. It was also recommended that this smelter should be located on the Roan Antelope, and, furthermore, a suggestion was advanced that the railway from N'Dola to the Roan Antelope should be continued to N'Kana. That negotiations embodying these eventualities reached an advanced stage in London and in Rhodesia is now no secret, but the technical advisers to the Rhodesian Anglo-American-Edmund Davis group of companies demurred. They argued that such a procedure would place too much power and control in the hands of the Chester Beatty-Selection Trust group. They pointed out that the man who owns the copper smelter has the whip hand of the situation. Furthermore, they contended that a railway from N'Dola to the N'Kana mine, via the Roan, would be a very meandering line which would have to cross some difficult and broken country, and, therefore, it was subsequently decided that the commercial smelter idea should be abandoned and that the N'Kana mine should be served by a railway running more or less direct from N'Dola. The position in these respects is now briefly that the N'Kana line is undergoing construction and that there will be separate smelters at the Roan and N'Kana. The former of these will probably serve at least three Selection Trust mines—Roan, Mufulira, and Chambesi — and the N'Kana smelter will in all likelihood handle concentrates from N'Changa and from other mines which are almost certain to develop under Rhodesian Anglo-American auspices.

What Will Be the Eventual Output?

How many large copper mines will eventually be opened up and established on a big productive basis in Northern Rhodesia it is impossible to say. New discoveries are being made almost continuously in the spheres of prospecting influence of each of the two big controlling groups.

What eventual copper output may be reached by the whole of this Northern Rhodesian copper field no one can foretell. But already there is fairly reliable and authoritative talk of six known mines producing between them as much as 300,000 tons of metal per annum. Even this may not represent the total ultimate producing capacity of this astounding mineral field. The more closely one looks into the picture the more overwhelmed does one become, not only by the possibilities, but the probabilities as well, of the Northern Rhodesian copper fields. The probability is that not even the most optimistically minded as yet realize what the output may amount to or what far-reaching influences this copper field may not have on history.

At the Anglo-American annual meet-

ing, held in Johannesburg a few weeks ago, Sir Ernest Oppenheimer confessed that he was not at all sure that even the Rand itself would surpass Northern Rhodesia.

The world's greatest gold field is now producing at the rate of about forty-two millions sterling per annum. That is an immense figure, but if one takes a long view of it and takes into account the mines other than those enumerated in the foregoing, such as Kansanshi and the Lunsenfwa areas and Konsonso and the properties in the hook of the Kafue, it may be that Northern Rhodesia, which, until recently, was the mere domain of big-game hunters and traders and government officials, may even surpass the far-famed Main Reef Series in the value and magnitude of its mineral output.

Kansanshi

I made reference just now to Kansanshi, a property which is under neither the Selection Trust nor Rhodesian Anglo-American group control, but which is owned and administered by the Rhodesia Katanga company, of the Sir Robert Williams group. This is the oldest copper venture in Northern Rhodesia, and developments there continue to be excellent. It is considered probable that a branch line will be built from Kipushi, in Katanga, to Kansanshi; that a concentrator plant will be built at Kansanshi and concentrates smelted at the Lubumbashi smelter (Union Minière), though, on the other hand, the suggestion is made that the line from N'Kana westward should be continued on through N'Changa toward Kansanshi. This copper territory is so vast, and its potential value is as yet so little realized, that it is impossible at this time to indicate how developments may shape. But that it is going to make history in the mining world there can be no reasonable cause for doubt.

Another Butte City May Arise

Big towns will certainly arise along these South Central African copper belts—some optimists profess to see at least two Butte cities developing. Four towns of some size already are in existence—Elisabethville and Likasi, in the Congo; N'Dola and Broken Hill, in Northern Rhodesia. Speculation is rife at present as to whether these places are likely to increase in size and importance and as to whether other towns will by virtue of geographical situation in regard to the chief zones of production or other advantages displace the towns already in existence. In so far as Katanga is concerned, there has been much talk for the last fifteen months of the rise of a new habitation, to be named "Jadotville," at the junction of the Sakania-Port Francqui line with the prolongation of the Benguela Railway into the Congo.

There is now talk of another large township being established at or near Musonoi, the centre of what is termed the western group of mines situated 50 miles to the west of Tshilongo and on the projected Dilolo-Tshilongo railway.

So far as Northern Rhodesia is concerned, it now seems fairly certain that large mining townships will be established at each of the big copper mines, but that N'Dola will be the administrative capital, the marketing and distributing centre, and the railway junction of the Northern Rhodesia copper fields.

Within the next ten years N'Dola will probably become the largest town in all Rhodesia, and in the course of time it may be the biggest habitation of man in Africa between Johannesburg and the Nile.

Mr. Val Davies, a well-known engineer, has been engaged to report on matters relating to lighting and water supply. A scheme of sanitation is being worked out and N'Dola is well on the way to becoming a municipality. The inhabitants of this frontier town are enthusiastic with regard to its future, and with the influential backing of the Rhodesian Selection Trust there can be no doubt that a large, prospering, and well-laid out town will arise there.

[In view of the intense interest evinced in developments of the Rhodesian Copper region, *Engineering and Mining Journal* is glad to present the views of correspondents in London as well as in South Africa, the impressions of each of which reflect the prevailing local sentiment. As Mr. Walker observes, the big problems associated with copper production have already been solved, and the Rhodesian companies are therefore in a most advantageous position. However, one must remember that change and advance are not dependent on the existence of problems as an incentive—in progressive mining centers, at any rate. Mining practice may not be expected to change to any revolutionary extent, but milling and metallurgical practice on a mixed copper ore is by no means definitely standardized, and the extent and character of the Rhodesian ores suggest opportunities for the introduction of many modifications of existing technique.—Editor.]

Consolidation of Rhodesian Copper Mines in Near Future Appears Improbable

By George L. Walker
Special London Correspondent

London, Aug. 3, 1929—No consolidation of Northern Rhodesia copper companies appears to be in process. The persistent rumor to the effect that a merger is probable arises from the frequent conferences of officials, the objects of which are to arrange matters of general concern. An announcement was recently made that the several companies will unite in mobilizing and apportioning the available native labor supply. Information respecting a combined effort in other directions is likely to be forthcoming soon, but there will probably be no consolidation of companies till after the tonnage of ore resources in each property has been definitely determined.

As all eight of the companies developing and prospecting for copper in Northern Rhodesia—Bwana M'Kubwa, Rhodesia Congo Border, N'Changa, Roan Antelope, Rhodesian Selection Trust, Rhodesia Minerals Concession, Rhodesia-Katanga and Loangwa Concessions—are well supplied with working capital, and as any one of them could readily get, on favorable terms, all the additional money that might be needed, the advantages of a consolidation at this time are not apparent.

Few problems in this great new copper field now remain to be solved. The sulphide ores are all much of the same character, but are sufficiently different to require that each company work out its own concentration methods. Solving of such problems as may exist in connection with the leaching of oxidized ores probably will be left till after Union Minière du Haut-Katanga and Bwana M'Kubwa have had time to make further demonstration, except that N'Changa and Rhodesian Congo Border will conduct tests in a pilot plant or plants.

The problem of native labor supply arises largely from the rush with which activities are being carried forward, and from the fact that the present is the construction period. To induce the natives to change their occupations and places of residence on short notice is no easy matter. The region was a wilderness only a few years ago. Motor roads are being built, three or four railways are in construction, houses are being erected, water supplies provided, and much other work done that necessitates supplies of native labor.

In the early stages of each mining development wood fuel is used for steam power generation, and a large number of natives are needed to cut and deliver the wood. Scores of prospecting groups are in the field, each attended by a group of natives. All of these activities, as well as those of handling the immense quantities of equipment and supplies now arriving, are keeping natives out of the mines.

The numbers of natives available later will be larger. Completion of railway, road, and house building will also greatly increase the numbers available for mine development and plant construction. In all probability the native labor problem will thus tend to solve itself. This is strongly indicated by the fact that Union Minière had 348 fewer natives in its employ, and only 100 more whites, at the end of 1928 than at the end of 1927, and yet produced 23,300 tons more copper from the treatment of 181,000 tons more ore in the latter than in the former year. By the time the mines get settled down to production the native labor supply should be adequate.

Nearly all of the big problems associated with copper production have already been solved. This leaves the Rhodesian companies, starting late, in a highly advantageous position. Several different caving systems of mining have been tested sufficiently far under varying conditions in America so that the problem of ore extraction in Rhodesia can be approached understandingly. There will be no apex litigation, as no one has any rights outside vertical side and end lines, and Northern Rhodesia's government and laws are all that could be desired.

Only a moderate smelting capacity will be required, owing to the very high grade of the concentrates. When producing 50,000 tons (100,000,000 lb.) of copper annually, Roan Antelope will have only about 100,000 tons of concentrates, or 300 tons daily, to smelt. In consequence, Northern Rhodesia may not have more than two or three smelters when, and if, it passes Arizona as a copper producer.

Some interest has been excited here by the table presented at the bottom of p. 15 of the recently issued Year Book of the American Bureau of Metal Statistics. This table indicates that all ore reserves reported outside of Africa that average over 2⅛ per cent contain only 428,520 tons of copper, whereas those reported in Africa averaging over 3⅛ per cent contain 9,350,891 tons of copper.

As drilling is carried farther into new areas, the average grade, and also the widths of ore, seem to increase. Recently reported drill results have given the officials and stockholders of every company great cause for satisfaction, expectations being exceeded in most reports.

Quite naturally the assumption had been made that the excellent values cut by drills at shallow depth—that is, only a few hundred feet below the zone of oxidation—would be found later to be the result of secondary enrichment. The very deep holes recently completed in the N'Kana and Roan Antelope deposits, however, have disclosed higher than average values over good widths.

What puzzles one most is to determine which of the several developments in Northern Rhodesia is the one of outstanding importance. Between 50,000,000 and 75,000,000 tons of better than 5 per cent milling ore will, according to current opinion, be proved within 1,700 ft. of the surface at Mufulira. Astounding widths and grades of ore are being proved in the N'Changa deposit, both in the N'Changa property and beyond in Rhodesian Congo Border area; and the results of the deepest drilling in the whole region at N'Kana and in the four or five latest holes at Roan Antelope have rather more than confirmed the deductions of geologists.

The holes recently completed at Roan Antelope are of far greater importance than may at first appear. Nos. 33, 36, 42, and 48 in the original Roan area must have added many millions of tons to the reserves of proved ore, and Nos. 36 and 48 show that the ore-bearing beds of the syncline reach even greater depths than had been anticipated, thus also largely increasing the tonnage of probable ore. Holes Nos. 3 and 9 in the Roan Extension area and Hole No. 8 in the Muliashi area have proved both the continuance of the ore and the far greater spread of the syncline toward the northwest, and No. 3 has revealed good mineralization in one of the underlying beds.

While every one of the companies continues to make such remarkably favorable developments as the drilling reports show, the probability that they will arrive at terms for a consolidation in the near future seems highly speculative.

Acetylene Explosion at Trail Smelter Kills Two

TWO men were killed and another man was seriously injured on July 31 when an acetylene tank exploded at the Tadanac smelter of Consolidated M. & S., at Trail, B. C. The tank was projected 300 ft. into the air and fell on a wash house, crashing through the roof. The men killed were Nick Verush, who was 25 years of age, and John Baldock, aged 22.

During 1928 there were 858 accidents at the smelter, or 0.98 accidents per 1,000 shifts. The majority of the accidents were minor ones; only two were fatal. Investigations disclosed the fact that most accidents were caused by men dropping objects from their hands either while carrying them or using them.

Bullion Worth $65,000, Sunk 120 Ft. for 27 Years, Is Found

After reposing at the bottom of Slocan Lake for 27 years, bullion to the value of $65,000 was recovered recently by Fred Madison, a diver of Nelson, B. C., in the employ of C. F. MacDougall, contractor. The truck of bullion was lost in the process of loading the bullion on board a scow en route from Trail to Australia. It went over the end of the wharf, and neither the truck nor the man it carried with it could be located. It was discovered, in dragging the lake for the body of a boy who had been drowned, at a distance of 300 ft. from the wharf and in water that was about 120 ft. deep

Empire Zinc Mill Ready Soon

The new 500-ton mill of Empire Zinc Company, a subsidiary of New Jersey Zinc, at Gilman, Eagle County, Colo., is nearing completion, and will be ready for operation some time in the fall. Because of the narrowness of the canyon in which it is situated, the mill is built completely inside the solid rock that comprises the canyon wall.

Manganese Tariff Rate May Apply to 10 per Cent Ores

DOMESTIC producers of manganese have won a partial victory on the tariff. Though the rate remains at 1c. per pound of contained manganese, it is reported that the Republican members of the Senate Finance Committee have extended its application to all ores having more than 10 per cent metallic manganese. Spokesmen for the domestic producers claimed at the hearing before the Republican subcommittee that restriction of the duty to ores of more than 30 per cent manganese content was one of the reasons why the protection afforded by the 1922 law was not effective. They asked for a duty of 1½c. per pound on ores in excess of 30 per cent, 1c. per pound on ores in excess of 20 per cent, and ½c. per pound on ores in excess of 10 per cent manganese.

The date for submission of the revised tariff bill in the Senate has been set for Sept. 3. The second annual convention of the American Manganese Producers' Association will follow a week later. It will be held in Washington on Sept. 9-10. The program is now in preparation.

Railroad to Amulet Will Be Constructed Immediately

AMULET MINES, operating in the Rouyn district of Quebec, has announced that arrangements have been completed with Canadian National Railways for a spur line to the property to serve the new concentrator. Work on the road will be started immediately. General Engineering will build the concentrator, which will have a capacity of 300 tons daily. Diamond drilling has shown high-grade copper-zinc ore at a depth of 266 to 294 ft., medium-grade from 294 to 302 ft., and low-grade ore to the present bottom of the drill, 302 ft. Drilling is still in progress.

Standard Silver-Lead Mining Options Wonderful Mine

STANDARD Silver-Lead Mining has taken a lease and option on the Wonderful mine, at Sandon, B. C., from Cunningham Mines. The Wonderful has produced a considerable tonnage of high-grade silver-lead-zinc ore, which has been milled in the Alamo mill, but the chief attraction of the property to the Standard company is understood to be the prospect of finding a large lode of silver-lead-zinc ore, the rich float of which has been found in ground-sluicing the property from time to time; but, notwithstanding considerable exploration, the ore *in situ* has never been discovered. Standard will continue the search for this lode and at the same time will continue to work the known oreshoots on the property to greater depth.

Phelps Dodge Discontinuing Shovel Mining at Sacramento Pit, Bisbee, Ariz.

Ore Will Be Handled Through New Level at 500-Ft. Point of Sacramento Shaft—No Ore Encountered Yet by Copper Queen Exploration in Warren Area

ACCORDING to Capt. J. P. Hodgson, general manager of the Copper Queen branch of the Phelps Dodge Corporation, steam-shovel operations in the Sacramento pit, at Bisbee, Ariz., are being discontinued and the remainder of the ore in the pit will be removed by underground operations. For this work a new level has been driven at 500 ft. in the Sacramento shaft. In addition to the pit ore, a block lying to the north of the shaft is being developed from this level and prepared for block caving. These operations, according to Captain Hodgson's announcement, together with the present caving work in the 850 southeast extension, will provide ore for the company's mill below Warren for several years to come.

From the 500 level, glory-hole raises have been driven to the 400 level, where heavy grizzlies have been installed to catch the coarse ore from the pit. The ore is hauled from the chutes on the 500 level to the shaft by trolley motors in five-ton side-dump cars. From two to three months will be required to make the change from steam shoveling to glory-hole methods, and to dismantle the pit equipment. To handle all the ore through the Sacramento shaft, two new skips have been put in what were known as the man-compartments and which have heretofore been used exclusively for handling men and supplies. Three-deck, cages were in use, but now all four of the skips have been equipped with single-deck cages, which will be used to get the men of that part of the mine in and out at the ends of the shifts. The Gardner shaft has been equipped and is being used exclusively as a service shaft through which men, tools, timber, and equipment will be handled.

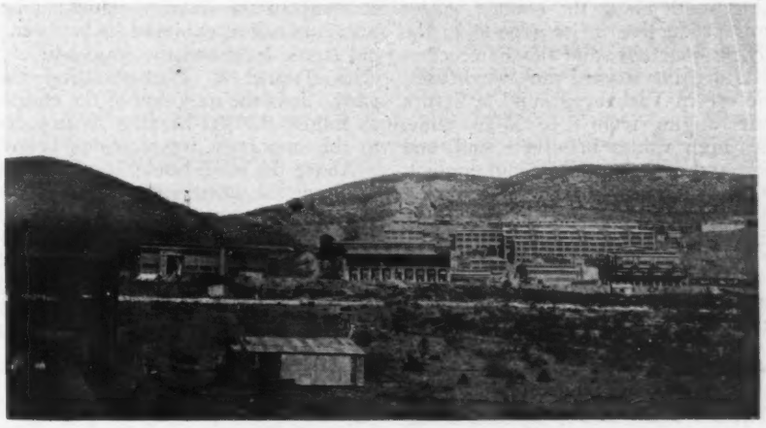
The 130,000 cu.ft. capacity blower formerly used for ventilation on the Sacramento 1,600 level has been placed on the 1,800 to give better ventilation to the lower part of the mine. On the surface new construction consists of new dumping pockets and conveyor belts to carry the ore to the railroad tracks over which it is hauled to the concentrator. The first section of a new change room has been constructed near the Gardner shaft. In the near future this change room will be enlarged to accommodate all of the men working in the Gardner, Lowell, and Sacramento divisions.

In the Warren development area, work is progressing on the 900, 1,100, 1,800, 2,000, and 2,200 levels, but to date no ore has been encountered, although some encouraging indications exist there. A diamond-drill hole is being put down below the large No. 7 waste dump located between the Douglas highway and the Warren cut-off. This hole will be sunk to a depth of over 2,500 ft. to obtain geological information of the underlying formations. Several caves have been struck, which have had to be filled with cement and the cement drilled through before the hole could be sunk further. No. 7 waste dump is to be leached, and pumps and pipe lines are now being installed. The solutions after percolation will be sent to the main precipitation plant below the mill.

Some interesting experiments relating to reclassification and grinding efficiency are being carried on at the concentrator. The mill organization has been doing splendid work for the last year and a half and extraction has materially improved. Mill capacity may be increased in the near future.

As has already been announced, a new crushing, sampling, and bedding plant will be erected at the Douglas smelter and an anode plant to permit the production of the copper in anode form, instead of blister bars, which eliminates one reheating of the metal and naturally results in a saving. The anodes will weigh about 700 lb. Blister bars as now made weigh 280 lb. In addition, considerable money will be spent around the two large furnaces. Changes will be made in the calcine bin system so as to permit a freer flow of calcines to the most desirable places in the furnaces. Screw feeders will be installed to reduce dusting while charging. It is also planned to cool the gases passing through the Cottrell system to increase its capacity.

Work on the new hospital over the dispensary in Bisbee is proceeding rapidly. The exteriors of the main buildings are practically finished and plastering and painting of the inside are now going on. The company feels that when the hospital is completed it will be strictly up to date and will serve its purpose better than the old one near Lowell, which will be torn down as soon as it is vacated.



The Copper Queen concentrator of Phelps Dodge, at Warren, Ariz., which may soon be enlarged

Magma Will Resume Depth Development Work

DEVELOPMENT work on the lower levels of the Magma mine in the Superior district of Arizona, which has been suspended for the last twenty months—ever since the disastrous fire of 1927—is expected to be resumed by January, 1930. Rehabilitation of the lower levels and concreting of the timbered sections of the shafts are being pushed.

Ore is being mined at the rate of 700 tons daily, and the smelter is producing 3,000,000 lb. of copper per month. The main shaft is to be sunk to the 3,100 level. No. 4 shaft, which is upcast, has been concreted from the surface to the 1,000 level and is to be sunk to the 1,500 level. A 600-ft. ventilation tunnel is being driven a mile east of the main shaft and under the Miami-Superior highway to ventilate the east section of the mine. The present power plant is to be increased from two to four turbines to meet future needs and to guard against curtailment of the power supply from the Roosevelt dam during dry years.

Wright-Hargreaves Strikes New Orebody on 500 Level

An important discovery at the Wright-Hargreaves mine, in the Kirkland Lake district of northern Ontario, is officially reported. The crosscut on the 500 level has encountered 25 ft. of ore at a point about 800 ft. west of the Sylvanite boundary. Although the deposit is in the continuation of the No. 2, or south, break, officials state that it represents an entirely new orebody. Since the cut in production to 350 tons daily, output is being gradually increased.

Strike at Tarbaby Stimulates Activity in Big Cottonwood Area

EVER since the discovery of the Cardiff orebody in 1914 and the demonstration of the importance of the Cardiff overthrust limestone-quartzite contact, operators in the Big Cottonwood-Alta-American Fork district, in the Wasatch range, about 30 miles southeast of Salt Lake City, have been searching for a duplication of conditions that were apparently responsible for the Cardiff bonanza. Interest in exploration of the Cardiff contact was stimulated during the winter by the strike in the Tarbaby property. This discovery was the first of any importance in many years in the Big Cottonwood area; it proved the overthrust to be mineralized nearly a mile north of the Cardiff orebody.

Three companies in the Big Cottonwood district are now pushing development either on or near the contact. Leasers in Tarbaby ground are taking out the ore proved for a length of 140 ft., and a shipment is to be made in a few days. The Howell company is pushing south along the contact to cut fissures productive in its ground in the overlying quartzite, and the Price company is drifting toward the overthrust.

The ore in Tarbaby ground, a fissure deposit ranging from 8 to 14 in. wide, carries high values in silver, lead, and copper, and an appreciable gold content. Both Tarbaby and Howell are working from the Tarbaby main tunnel. Price has its own adit.

In the Silver Fork gulch area of the Big Cottonwood section, the Alta Tunnel & Transportation Company is conducting operations just above the main tunnel level, and also in the upper levels, about 800 ft. higher, where the Prince of Wales vein has been followed down below the old workings. From this vein the Walker Brothers, of Salt Lake City, took over a million dollars nearly sixty years ago. Two overthrust contacts in the district, which had not previously been explored lie between the old Annie level and the main adit of the Alta Tunnel & Transportation Company. It is the intention of the company to follow the ore-bearing fissure down to the important intersections below.

Above the main tunnel level, the company opened up recently in a 60-ft. raise 4 ft. of complex zinc-lead-silver ore, west of the Christmas stope. Another raise is being put up east of the discovery raise in the hope of catching the same limestone bed on its dip, so that more economical mining can be effected.

Tintic to Celebrate Sixtieth Anniversary

TINTIC, Utah's leading silver camp, will celebrate on Aug. 28 its sixtieth anniversary as a producing district. A special program is to be held and invitations are being sent to all parts of the state, so that the pioneers, who founded an industry productive of $314,349,924 in ore and $49,673,760 in dividends, may be appropriately honored.

Ryan Predicts Continued Prosperity for Butte

PRODUCTION from the mines of the Butte district for the first half of 1929 equaled the maximum output for any similar period, stated John D. Ryan, chairman of the board of directors of Anaconda Copper, in a recent address before the civic clubs of Butte. All indications point to a continuance of the prosperity that has made Butte one of the great mining camps of the world, Mr. Ryan declared.

Average grade of ore taken from Anaconda mines is higher than it was 25 years ago, and at the same time reserves are greater and metallurgical recovery is better than at any time during that period. The payroll of the Butte mines is now equaling the best record of all time. With the copper situation most encouraging, world consumption for this year exceeding the maximum consumption during the World War by fully one-third, or one billion pounds, such conditions should continue.

Anaconda's policy of manufacturing the metals produced in Butte is an insurance that the dark days of 1921, when the mines were idle for nine months, will not recur, declared Cornelius F. Kelley, president of the company, whose address followed Mr. Ryan's and echoed his optimism.

New California Ore Buyers' Regulations Go Into Effect

WALTER W. BRADLEY, California State Mineralogist, announces that the amendments passed by the recent session of the legislature to the Ore and Bullion Buyers' License Act has become effective Aug. 14. Of particular importance to the prospector and the smaller operators in the mountain districts is the amendment making an annual license fee of only $2, without the necessity of a bond, for those local merchants who will purchase not to exceed a total of $1,000 in gold or silver bullion or material per calendar year. The license fee for purchases totaling over $1,000 will be $15 a year, likewise without bond.

Any person or firm desiring a California Ore Buyers' License should write to the State Mineralogist, Ferry Building, San Francisco, for an application blank.

Reduce Mine Dust by Adding Shale Dust, Suggests Haldane

Dr. J. S. Haldane, noted British physicist, made the suggestion at one of the recent meetings of the British Association for the Advancement of Science, at Cape Town, that miners' phthisis might be combated by introducing shale dust. According to his theory, the hard silica dust that causes the disease would be counteracted by the soft shale dust. Silica dust in mines cannot be laid by the addition of moisture, as saturation of the atmosphere at deep levels is as dangerous to health as the dust menace it is designed to overcome. Dr. Haldane's theory aroused much discussion at the meeting.

Treadwell-Yukon Increases Capacity of Tybo Mill

W. H. Blackburn, manager of the Treadwell-Yukon property at Tybo, Nye County, Nev., states that the Tybo mill is now treating over 200 tons daily. Tonnage will be increased to 350 daily as soon as additional ore chutes, now under construction, are installed. There are now 140 men on the Tybo payroll, of whom 11 are employed in the mill.

Construction at Sudbury Keeping Up to Schedule

Referring to the construction program in which International Nickel is involved in the Sudbury district, R. C. Stanley, president of the company, stated on a visit to the properties recently that work is proceeding according to schedule. Both the new smelter and the Frood mine will be in full operation about the middle of 1930, if the present rate is maintained. International Nickel will continue its operations in Great Britain, despite the very large program of expansion on this side of the water. John L. Agnew, vice-president of the company, will visit the English properties this fall. Continued expansion of the market for nickel and a consequent increase in production were forecast by Mr. Stanley. Use of nickel cast irons is a prime factor.

Pend Oreille Builds Hotel at Metaline Falls

Pend Oreille Mines & Metals has started construction of a large hotel at Metaline Falls, Wash., to house men who will be employed on the construction of its 2,000-ton concentrator and electrolytic zinc plant. As soon as the hotel is finished, work on the first 1,000-ton unit of the concentrator and 150-ton unit of the zinc plant will be started. It is expected that both plants will be in operation by September, 1930.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Vipond Reserves Maintained Despite Increased Output—Dome Denies High Grade

TORONTO, Aug. 10, 1929—The fiscal year of the Vipond mine, in the Porcupine district of northern Ontario, ended on July 31. For the first time in several years the annual report, now in course of preparation, will not show any depletion in ore reserves. Last year reserves were estimated at a gross value of $890,000. Despite a production of over $800,000, the largest in the history of the mine, ore reserves will stand at about the same figure. Costs have been reduced to $5.15 a ton, leaving a profit of $2.75 a ton, or a total for the year of $250,000 after all allowances. During the last year production has been steadily increasing, from $180,000 in the first quarter to $225,000 in the last quarter.

DURING July Dome Mines, also in the Porcupine district, milled 45,310 tons and recovered $320,626, an average of $7.08 a ton. This represents a decrease over the record for the two previous months, which included the clean-up period, but is better than the corresponding month of 1928.

An official denial has been made regarding extensive claims made for the high-grade ore in the greenstones. The general manager states that the ore is not high grade and that it averages only about $5 a ton. The bodies are also very irregular, both in shape and grade. At present 40 per cent of the ore milled is coming from the greenstones and the remainder from the sediments. The outlook for new discoveries in the sediments is not considered encouraging.

Announcement has been made of the formation of the new Coniaurum company. This is considered the last step in the rearrangement of this company's affairs and clears the way for Ventures, Ltd., to take over the financing and operation of the mine. Since Coniaurum went into the receivers' hands there has been a decided improvement in the financial situation. A profit of approximately $10,000 a month is being realized, but it is at the expense of development and exploration, which have been stopped entirely.

Encouraging results are reported from the old St. Anthony mine, at Sturgeon Lake, in northwestern Ontario. The mill was recently started. About 50 tons a day is being treated. The mill has a maximum capacity of 100 tons a day. Practically all the ore is coming from the 250 level, but new ore has recently been found at the 150 and 500 levels.

Moss Mines, in northwestern Ontario, is another old property which has been reopened. On the 375 ft. level, 300 ft. of ore has been developed, of which 160 ft. is high grade, over a width of 30 in. The face of the drift is still in ore. To date 45,000 tons of good grade ore has been developed, and the company has now decided on the erection of a mill, equipment for which will be transported to the property next winter.

Canadian Explosives, a division of Canadian Industries, Ltd., has announced another reduction of 25c. per 100 lb. on explosives throughout Canada. This is the eighth reduction within the last thirty months and is in line with the announced policy of Canadan Industries of reducing prices as economies are effected.

Landslide Forces Closing Durango Plant A. S. & R.

A LANDSLIDE, carrying mud and rocks, wrecked the moisture house and drying sheds of the Durango, Colo., plant of American Smelting & Refining, on Aug. 6. The entire plant, with the exception of the sulphating unit, has been forced to shut down. About two weeks' time will be required to put the plant in condition to resume general operations.

Ritchie Gold Progresses in Mine Development

Mine development at Ritchie Gold Mines, Ltd., in the eastern section of the Kirkland Lake district of northern Ontario, has been steady. It is expected that the No. 1 vein will be reached by the end of the month. The main crosscut at the 500 level has advanced 198 ft.

Timbering of the sump has been completed, and the bulkhead placed at the 500 level. Pumping has also been installed at this level, and the level widened by slashing to allow switching of ore cars. A survey of the shaft has been completed.

Univ. of Arizona Continues Mine Administration Course

A ONE-YEAR graduate course in the administration of mineral industries is again offered by the college of mines and engineering, University of Arizona. This course is given under the direction of Dr. E. P. Mathewson and leads to the degree of administrative engineer of mines.

The first semester is spent in campus work; the second semester alternates two-week periods of campus work and field study in leading mines and smelters of the state. Applicants must have at least a bachelor's degree in mining engineering or metallurgy and must have had at least three years of practical experience. Further information may be obtained from G. M. Butler, Dean, College of Mines and Engineering, Tucson, Ariz.

Mexico City Letter

BY W. L. VAIL

Special Correspondent

Mexico Amends Constitution to Permit Passing of the Proposed Labor Law

MEXICO CITY, Aug. 9, 1929—Both chambers of the Mexican Congress approved the adoption of changes in the Federal Constitution which will permit the passage of the proposed labor law. Notices of this action have been radioed to the various state authorities to save time. Every state legislature is expected to approve the action of Congress. The different provisions of the new labor code that immediately and indirectly affect the mining industry are not legion, but are numerous enough to insure a panic among operators, if passed as presented. They are to be discussed, and the hope remains that there will be modifications. Congress almost certainly will decline to authorize the president to decree the code as a whole, but will insist upon its own prerogative to discussion.

THE new road in Lower California, which connects all the important mining camps of the peninsula, has been formally opened. It is 961 kilometers long, from the American border to the Cape of San Lucas, with laterals bringing the total up to 1,800 kilometers. The principal towns and camps touched are San Jose del Cabo, San Lucas, La Paz, Todos Santos, Miraflores, Santiago, San Bartolo, San Antonio, El Triunfo, Los Frailes, La Ribera, the Bay of Magdalena, San Luis, Comodu, La Purissima, Mulege, Loreta, Santa Rosalia, San Ignacio, and Calmalli. A passable road has also been constructed north from the Bay of Magdalena, through San Quentin to Ensenada. By this new system of roads, practically every mining district of importance in Lower California can now be reached easily.

The La Yesca district, in the State of Nayarit, which has been almost abandoned for the last fifteen years, is being reopened, and several small mines are expected to be shipping ores before the end of the year. Other properties in Nayarit and in southeastern Sinaloa may be reopened within a short time.

Mexican Workers Petition to Run Mines

Workers in the La Muralla and Noche Buena mines, in the State of Zacatecas, Mexico, confiscated by the federal government along with other landed property of ex-General Eulalio Gutierrez, who took part in the recent rebellion, have petitioned the attorney general to turn these plants over to them to be conducted on a co-operative basis. It is understood that the government is considering the petition favorably.

MARKET AND FINANCIAL NEWS

Value of British Columbia Mine Output Up in First Half of Year

THE Provincial Department of Mines has issued an estimate of the mineral production and a summary report of mining activities in British Columbia, covering operations during the half year ended June 30, 1929. The estimate and report have been compiled by John D. Galloway, provincial mineralogist.

Production for the half year is estimated at 90,000 oz. of gold, 5,250,000 oz. of silver, 51,000,000 lb. of copper, 145,000,000 lb. of lead, 91,000,000 lb. of zinc, 1,172,645 long tons of coal, and structural materials and miscellaneous minerals to the value of $2,488,630. Included in the last are 279 tons of cadmium and seven tons of bismuth. The value of the production is placed at $35,256,063, which augurs well for a production of more than $70,000,000 for the full year, as against $67,188,843 in 1928. Thus, though the productions of gold, silver, and lead were less than in the first half of last year, and the productions of copper and zinc only slightly more, owing to the advances in metal prices the value of the production was more than one and a half million dollars more than it was in the first half of last year.

In a review of the half-year's activities, Mr. Galloway singles out as the most important events the expansion of the activities of the Consolidated Mining & Smelting Company of Canada, particularly the lead-slag plant, which is likely markedly to increase the company's zinc output during the second half of the year; the entry of Noah A. Timmins into the British Columbia mining field; discovery of stannite at the Snowflake mine, this as yet being more of mineralogical than commercial importance; the increase of the milling capacity at the Britannia mine to 6,000 tons per day; satisfactory development of the Ferguson mine, on the Ingenika River, indicating the existence of another large silver-lead-zinc district; the encouraging nature of recent development at B. C. Silver mine, together with the discovery of unexpected ore in the lower levels of the Premier mine; the bringing to production of the Bonanza mine by the Granby Consolidated Mining, Smelting & Power Company—this mine is now producing 11,000 tons of copper ore per month; the discovery of what promises to be an important new copper district on the Kingman property, at the extreme northern end of Vancouver Island, if the surface showing persists to any appreciable depth; the general activity in the West Kootenay district; and the starting on the construction of a 350-ton mill at the Monarch-Kicking Horse mine and a 100-ton mill at the Union mine, both of which are expected to be in operation before the end of the year.

In the reports by the six provincial resident mining engineers, George A. Clothier's report of the new copper district at the north of Vancouver Island and B. T. O'Grady's report of the occurrence of tin at the Snowflake mine are the outstanding events described.

WALKER MINING COMPANY earned an operating profit of $497,431 during the first six months of 1929.

UNITED VERDE EXTENSION MINING COMPANY produced 4,470,000 lb. of copper in July. In June the company produced 5,020,000 lb. of copper, and in July, 1928, 3,535,742 lb.

UNFILLED ORDERS for brass and bronze ingots and billets on the books of the members of the Non-Ferrous Ingot Metal Institute Aug. 1 totaled 13,243 tons.

AHUMADA LEAD COMPANY reports for the six months ended June 30, 1929, a net loss of $20,516, after deducting depreciation, taxes, and all other expenses. This compares with a net loss of $76,297 in the first half of 1928 and an income of $229,425 in the similar period in 1927. For six months of current year 13,475 tons of ore was produced, for which the smelter returned 5,624,470 lb. of refined lead.

WORLD'S PRODUCTION OF TIN in the second quarter of the current year is placed at 44,384 tons, against 41,408 tons in the first quarter, according to the Anglo-Oriental. Consumption in the April-June period amounted to 48,007 tons, it is stated, against 37,820 tons in the previous quarter.

ALASKA JUNEAU IN JULY mined and trammed to mill 321,200 tons from which estimated receipts were $282,500, or 87.95c. per ton; operating expenditures $169,000, or 52.61c. per ton; and operating profit, $113,500, or 35.34c. per ton. Other expenditures and accrued charges were $16,600, leaving $96,900 to surplus for the month.

London Financial News

BY W. A. DOMAN
Special London Correspondent

LONDON, July 30, 1929.—Although the mining-share market has been neglected and dull, base metals have received a good deal of attention. Principally has it been directed to Rhodesia again, copper having come prominently before the public. Rhodesian Congo Border Concession, in conjunction with the Société Generale des Mineraux, of Brussels, has formed the Kipushi Syndicate, to deal with mines and minerals in any part of the world. The initial capital is £60,000 in 5s. shares.

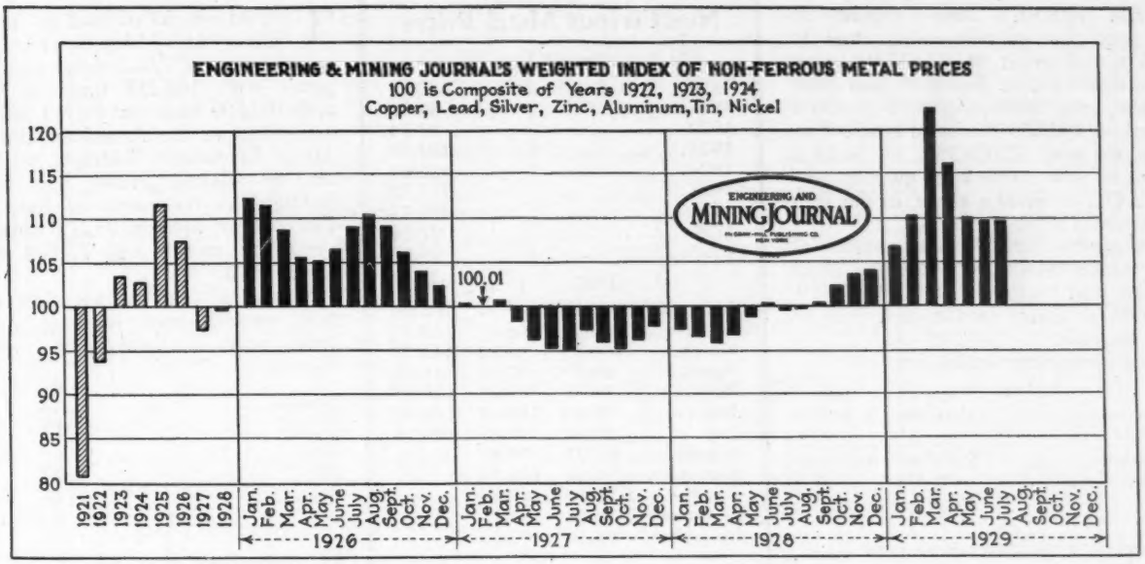
The disappointment caused by the failure of the Lydenburg fields, in the Transvaal, to come up to expectations has not deterred the Waterval-Rustenburg Platinum Company from starting operations on what is known as the Merensky reef. The mine is equipped to deliver ore at the rate of 10,000 tons monthly.

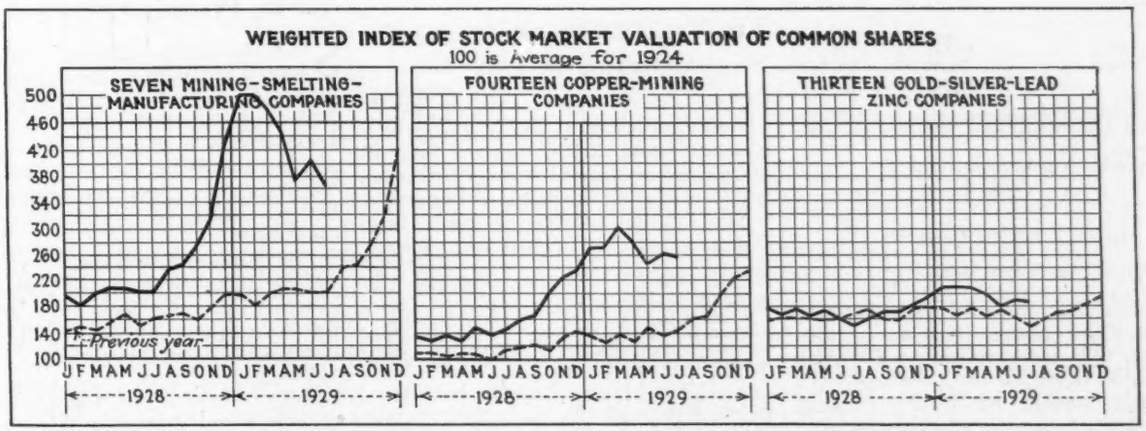
A. Chester Beatty has engaged in a new venture, this time in Yugoslavia. He has formed a company, Trepca Mines, with an authorized capital of £1,000,000 in 5s. shares, to acquire mining rights over an area of about 400 square miles. Lead, zinc, and silver form the main content of the orebodies, and it is estimated that some 1,750,000 tons of ore has been proved. A concentrating plant of 500 tons' daily capacity, and a power plant, are to be erected. Promising prospects are also being investigated at a place called Stantrg.

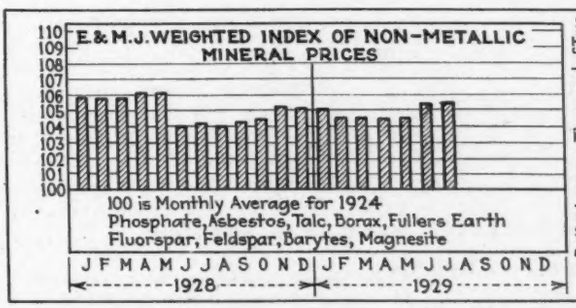
ENGELS COPPER MINING COMPANY reports operating profits for the first six months of the year aggregated $300,244 from a production of 5,761,522 lb. of copper. Plans for financing the Calaveras Copper Company have been about completed, the Engels company to pay into a newly organized company $125,000, in return for 51 per cent of the stock in the new company, the foregoing sum to be used for working capital.

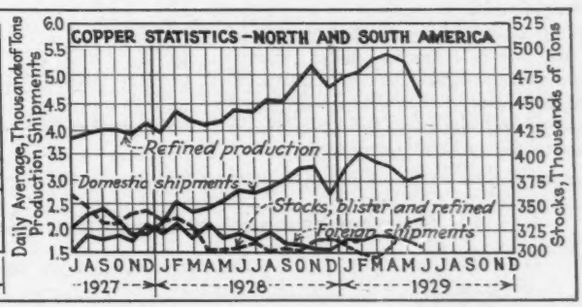
CALUMET & ARIZONA MINING COMPANY, in the quarter ended June 30, showed a profit of $805,325 before depreciation, compared with earnings in the March quarter of $3,690,617. Decrease in earnings was caused, in part, by the fact that sales of copper for the quarter were small. Though the output of Calumet & Arizona and New Cornelia for the June quarter was higher than for the preceding quarter, gross income for three months ended June 30 was $4,723,751, compared with gross income for the two companies of $7,791,751 in the March quarter.

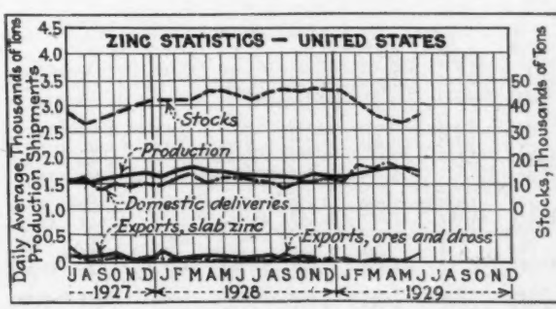
E. & M. J. Statistics of the Mining Industries

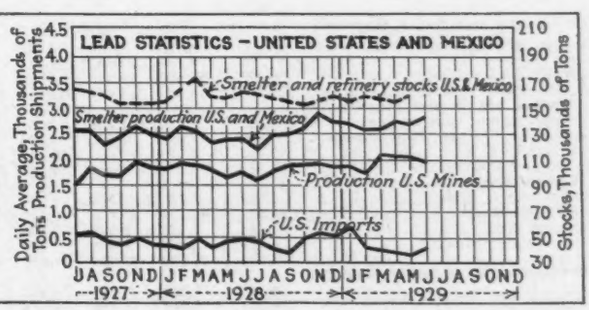





E. & M. J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth
Fluorspar, Feldspar, Barytes, Magnesite
1928
1929







New Jersey Zinc Earnings Well Above 1928 Level

NEW JERSEY Zinc Company reports for quarter ended June 30, 1929, a net profit of $2,447,806 after taxes, depreciation, depletion, and other charges, equivalent to $4.98 a share earned on 490,816 shares of stock. This compares with $2,026,934, or $4.13 a share, in the preceding quarter and $1,812,431, or $3.69 a share, in the June quarter of 1928.

Net profits for first six months of 1929 totaled $4,474,741, equal to $9.11 a share, and compares with $3,461,459, or $7.05 a share, in the first half of previous year.

Income for quarter ended June 30:

	1929	1928
(a) Total income	$2,447,806	$1,812,431
Interest	.....	.....
Net profit	$2,447,806	$1,812,431
Dividends	981,632	981,632
Surplus	$1,466,174	$830,799

Income for quarter ended June 30:

	1929	1928
(a) Total income	$4,474,741	$3,461,459
Interest	.....	.....
Net profit	$4,474,741	$3,461,459
(b) Dividends	3,926,528	2,944,896
Surplus	$548,213	$516,563

(a) Includes dividends received from subsidiaries and after taxes, depreciation, depletion and other charges.

(b) Includes dividend payable Aug. 10.

Platinum Production in South Africa Increasing

SALES and shipments of platinum and allied metals from the Transvaal in 1928 were valued at £241,110, against £144,191 in the previous year. A large amount of work is being carried out on the platinum-bearing formations in that territory, and a considerable rise in output is probable, according to a survey by the Standard Bank of South Africa. Much apprehension exists regarding the future of the market, and it has been suggested that ultimately it may be possible to exercise some control of output.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54
1928	99.78

	1927	1928	1929
January	100.46	97.54	106.86
February	100.01	96.73	110.37
March	100.84	96.22	122.71
April	98.63	97.14	116.36
May	96.41	99.05	110.03
June	95.55	100.16	109.66
July	95.42	99.69	109.58
August	97.25	99.85	.....
September	96.01	100.53	.....
October	95.36	102.34	.....
November	96.22	103.83	.....
December	98.30	104.28	.....

Tin Visible Shows Slight Decline in July

THE visible supply of tin on July 31 was estimated at 23,772 tons, which compares with 23,936 tons on June 30 and 18,073 on July 31 last year, according to Ricard & Freiwald, of London.

Supplies and deliveries of tin in July, compared with July of last year, follow:

Supplies (tons)	July, 1928	July, 1929
Shipments, Straits to U. K.	2,147	2,040
Straits to U. S. A.	4,520	4,690
Straits to Continent	795	675
Straits to other countries	1,249	488
Australia to Europe and U. S. A.	115	15
Banka	999	879
Standard arrivals in U. K. and U. S. A.	1,674	1,941
Total	11,500	10,728
Deliveries:		
United Kingdom	1,303	1,700
Holland	811	537
Continent (except Holland)	1,232	1,355
U. S. A.	5,545	6,865
Other countries	991	435
Total	9,882	10,892

Lead Stocks in U. S. and Mexico Show Gain

TOTAL stocks of lead in the United States and Mexico on July 1 amounted to 173,612 tons, which compares with 162,255 tons on June 1, and 163,709 tons on July 1 last year, according to the American Bureau of Metal Statistics. Receipts of lead in ore by United States and Mexican smelters for the month of June totaled 78,216 tons, against 85,378 tons in the preceding month and 77,108 tons in June, 1928.

Stocks of lead on the first day of each month since January, in short tons, with a comparison, were as follows:

	1929	1928
January	161,460	156,290
February	156,182	157,417
March	160,597	167,692
April	158,149	173,411
May	156,888	161,207
June	162,255	159,375
July	173,612	163,709

British Mining Shares To Be Placed on Curb

SHARES of the Mining Trust, Ltd., one of the mining share issues dealt in in London, will be introduced on the New York Curb shortly, according to advices from England. Introduction of this stock will be the first public participation of American capital with British capital in world-wide mining enterprises.

The Mining Trust, Ltd., was organized in June under the auspices of the Russo-Asiatic Consolidated Company and took over practically all of the assets of that corporation.

The Mining Trust, Ltd., owns a controlling interest in the Mount Isa Mines, in Queensland, Australia.

ARGENTINA PRODUCED 4,029,784 kilos of lead ore in 1928, compared with 3,392,413 kilos in 1927, according to preliminary figures furnished by the Argentine Director General of Mines. There was no production of antimony in that country during 1928.

Current Statistics of Production and Stocks of Copper, Lead, and Zinc

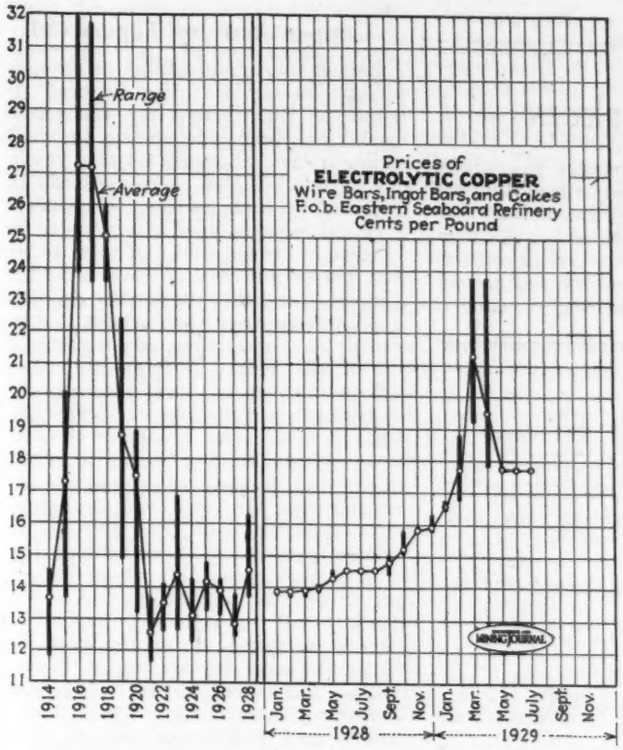
Data from American Bureau of Metal Statistics

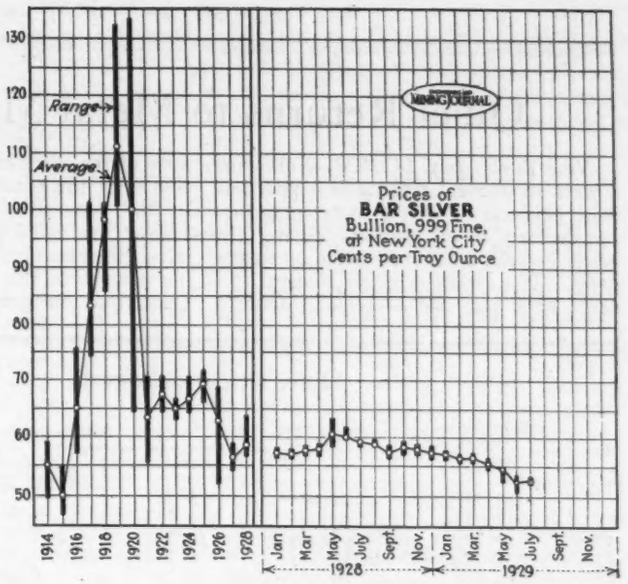
Figures Represent Short Tons

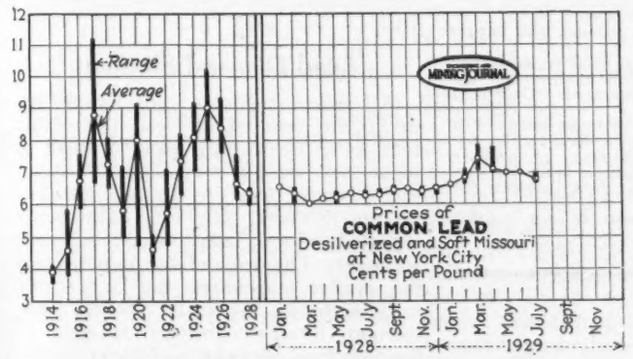
	1927	1928					1929					
COPPER—North and South America	Average	Feb.	March	April	May	Average	Jan.	Feb.	March	April	May	June	July
Production, refined, daily average	4,045	4,305	4,160	4,094	4,169	4,448	4,983	5,049	5,276	5,378	5,219	4,630	4,952
Domestic shipments	68,737	73,789	72,642	72,234	79,103	81,955	100,135	98,771	105,860	99,051	93,743	95,258	98,720
Foreign shipments	53,489	60,603	55,970	64,989	56,738	57,185	57,054	50,150	59,946	57,708	55,123	48,461	40,204
Stocks, blister and refined	335,311	318,161	313,408	291,985	291,743	300,771	307,959	296,298	295,309	311,003	332,641	334,621	337,199
LEAD—United States and Mexico													
Production, smelter, daily average	2,513	2,630	2,608	2,208	2,345	2,514	2,656	2,559	2,617	2,720	2,792	2,777	.....
Production, U. S. mines, daily average	1,798	1,896	1,872	1,671	1,661	1,785	1,891	1,723	2,118	2,083	2,067	1,925	.....
Imports into U. S. A.	13,451	8,574	12,556	10,314	12,439	12,757	22,924	9,551	8,383	7,115	6,990	9,481	.....
Stocks, smelter and refinery	156,878	167,692	173,411	161,207	159,375	160,511	156,182	160,597	158,683	156,888	162,255	173,612	.....
ZINC—United States													
Production, daily average	1,681	1,726	1,803	1,783	1,723	1,693	1,604	1,720	1,790	1,822	1,837	1,708	1,756
Domestic deliveries	45,811	46,754	51,856	46,517	49,818	48,301	47,677	51,057	56,267	56,558	56,614	47,973	47,251
Exports, slab zinc	3,468	2,125	2,558	2,620	2,148	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Exports, ores and dross	4,424	890	1,898	155	361	453	545	165	483	308	358	266	.....
Stocks	37,602	41,290	41,529	44,759	45,225	44,333	45,418	40,620	37,962	34,588	33,826	36,932	44,122
World Production Rate (Daily Average)													
Copper	4,543	5,088	4,769	4,881	5,046	5,236	5,767	5,968	6,219	6,361	6,229	5,802	.....
Lead	4,514	5,067	5,158	4,868	4,774	4,976	5,037	5,068	5,176	5,418	5,440	5,467	.....
Zinc	3,910	4,285	4,394	4,352	4,248	4,271	4,231	4,357	4,448	4,357	4,528	4,483	.....

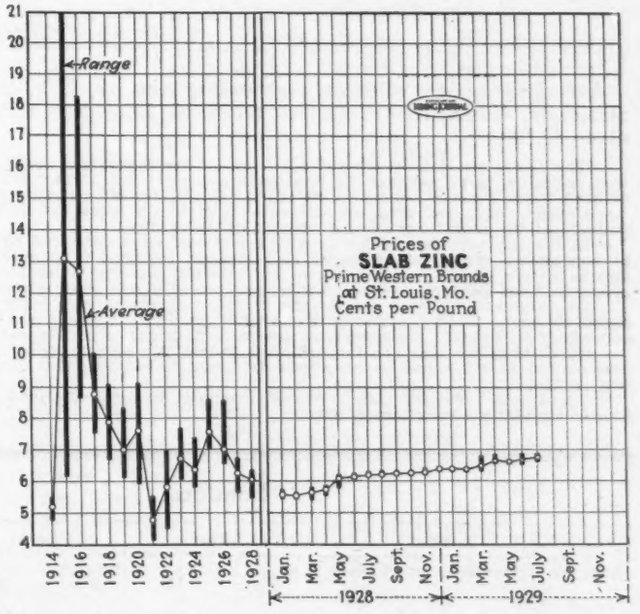
(a) Withheld pending investigation of government reports.

Metal Price Curves

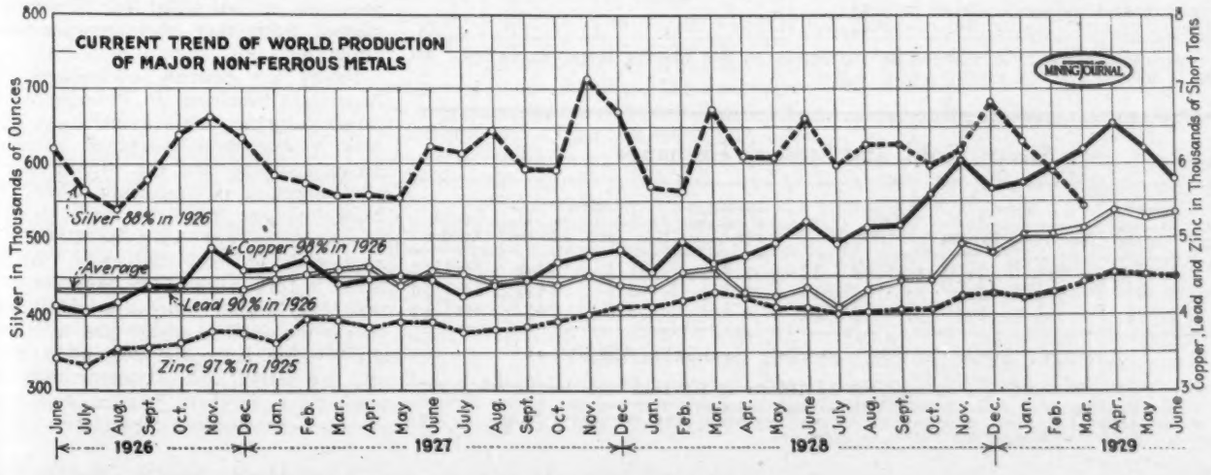








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926, and accordingly the horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88% in 1926
Copper 98% in 1926
Average
Lead 90% in 1926
Zinc 97% in 1925
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1926
1927
1928
1929

The Market Report

Quiet Returns to Metal Markets

New York, Aug. 14, 1928—Following a week of unusual activity in copper and lead, business in all the more important non-ferrous metal markets during the week ending today has been unusually quiet. The advance in the Federal Reserve bank rate and subsequent disturbance of the stock exchanges, in conjunction with the entanglement encountered in the reparations discussion at The Hague, has had a more or less demoralizing effect on metal markets in consuming centers of this country and abroad. Quotations in general are unchanged, though tin is slightly lower and quicksilver quotations in this market are approaching the "pegged" price level of the European cartel.

Daily Prices of Metals

Aug.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
8	17.775	46.875	6.75	6.55	6.80
9	17.775	46.625	6.75	6.55	6.80
10	17.775	No Market	6.75	6.55	6.80
12	17.775	46.375	6.75	6.55	6.80
13	17.775	46.375	6.75	6.55	6.80
14	17.775	46.375	6.75	6.55	6.80
	17.775	46.525	6.750	6.550	6.800

Average prices for calendar week ending Aug. 10, 1929, are: Copper, 17.775; Straits tin, 47.025; New York lead, 6.750; St. Louis lead, 6.556; zinc, 6.800; and silver, 52.500.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic bid	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
8	73 13/16	74 11/16	84¼	211⅛	215⅜	23⅜	23 5/16	24 15/16	25 3/16
9	73 5/16	74 3/16	84¼	209¼	213¼	23⅛	23 1/16	24 9/16	24 7/8
12	73⅝	74⅝	....	209⅛	213⅛	23 3/16	23⅛	24½	24¾
13	73 15/16	74⅞	84¼	208⅛	212⅛	23¼	23¼	24⅞	25
14	74 5/16	75 1/16	84¼	208¼	212½	23 1/16	23⅛	24 13/16	25 1/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
8	4.84 7/16	52⅛	24 3/16	84s11½d	12	4.84⅛	52⅛	24 3/16	84s11½d
9	4.84¼	52⅛	24¼	84s11½d	13	4.84¼	52⅛	24 3/16	84s11½d
10	4.84⅜	52⅛	24¼	.....	14	4.84¼	52⅛	24¼	84s11½d

Average: Silver, 52.458c.; Sterling Exchange, 484.302c.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Activity Tapers Off

Except for a continuation of the good foreign buying that has featured the month of August thus far, the copper market has been quiet during the week ending today. Statistics released yesterday by the A.B.M.S. were variously interpreted by trade factors. Consumers, of course, were inclined to emphasize the increase in refined stocks of some 14,000 tons, but an impartial observer would be inclined to feel that the further decrease in production more than offsets this increase; the stocks even now amount to but 98,000 tons. Foreign shipments declined further in July, reaching the lowest level in some time at 40,000 tons. However, this factor is capable of varying interpretation, also, though it seems certain that monthly shipments for the remainder of the year will be appreciably in excess of the July figure.

Sales to domestic consumers during the last week were only about 75 per cent of normal, but except for a relatively small tonnage for September delivery, virtually all of the business was for shipment during August. Prices remain unchanged at 18c. delivered Connecticut valley basis in the domestic market, and 18.30c. per pound, c.i.f. usual European destinations, continues as the quotation of Copper Exporters, Inc.

Lead Demand Slackens

All sellers report a considerable let-up in the demand for lead this week, total sales being only about a third of what they were a week ago. Most of the business was in carload lots for prompt delivery, only four sales being reported where later deliveries were specified. The demand was mostly from the smaller consumers, the large cable manufacturers especially being conspicuous by their absence, in spite of the reported activity of their plants. Battery makers are well satisfied with the prospects for a good fall business and some have been increasing their specifications on contract orders.

The indications are that most of the August requirements have now been provided for, but about half of the open market September lead remains to be purchased.

Prices are entirely unchanged; the American Smelting & Refining Company's contract basis remains at 6½c., New York, which is quoted by other Eastern sellers, and the Middle Western quotation is uniformly 6.55c., St. Louis. There has been some thought of trying to get 6.575 or 6.60c. for September or later deliveries, but interest in forward lead has been so small that the higher quotation has been purely nominal. London has eased off slightly, but European demand is good and the market abroad seems stable at present. Corroding grades command the usual premium of $2@$3 per ton.

Zinc Unchanged

Sales of Prime Western zinc in the last week amounted to considerably more in the aggregate than for the week or two immediately preceding, but the market could hardly be termed active in any sense of the word. One good-sized tonnage for November-December delivery changed hands earlier in the week, but all of the other business was for prompt and near-by delivery. All business was on the basis of 6.80c. per pound, delivered East St. Louis.

Tin Easier

Demand for tin has not been especially active, though consumers have taken fair tonnages for prompt shipments, especially yesterday, doubtless being attracted by the slightly lower prices asked. The shading of prices seems to have been occasioned by the release of tin in London, rather than lack of inquiry by consumers. Forward deliveries are held at considerably higher prices than are asked for prompt, a premium of about ¼c. per month being quoted. Banca and 99 per cent grades are very scarce.

Silver Dull But Steady

During the last week the silver market was again dull and featureless; with the exception that on Aug. 8 local prices remained unchanged, whereas the London price fluctuated between 24 5/16 and 24 7/16d. Reports indicate that India has shown some interest as a small buyer and China has operated both ways. The undertone is steady.

Mexican Dollars (old Mexican pesos): Aug. 8th, 39¾c.; 9th, 10th, 12th, 13th, and 14th, 39⅞c.

Foreign Exchange

Closing cable quotations on Tuesday, Aug. 13, were as follows: Francs, 3.91c.; lire, 5.22¾c.; and marks, 23.81⅜c. Canadian dollars, ⅛ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8⅝c. per lb. for all positions. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 80@90c. Active demand.

IRIDIUM — Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $125@$126. Business placed during week at $125 on round lots. Offerings light and market continues firm.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of Aug. 10.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.75@$16.00 for future delivery. Offerings of nearby material scanty and prices nominal. Bolivian scheelite is held at $16. Western scheelite quoted at $16.50 for October-November delivery.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the Aug. 10 issue.

Joplin Prices Unchanged

Joplin, Mo., Aug. 10, 1929

Blende

	Per Ton
High	$46.20
Premium blende, basis 60%	$44.00@ 45.00
Prime Western, basis, 60%	43.00@ 44.00
Table concentrates, 60%	41.00@ 43.00
Flotation concentrates, 60%	39.00@ 41.00
Average settling price	43.99

Galena

High	$87.30
Basis 80% lead	85.00
Average settling price	87.05

Shipments for the week: Blende, 13,083; lead, 1,180 tons. Value all ores the week, $678,200.

Unchanged prices ruled the zinc and lead ore market this week.

It is generally conceded that production of zinc ore is at or near a maximum. Some buyers believe it will recede rather than advance further. Though shipments for the week were 400 tons less than the production, a tonnage in excess of the production was purchased for future delivery.

The Evans-Wallower Lead Company has begun a preliminary purchase of zinc ore for the new Tainton process electrolytic plant at East St. Louis, and the Empire Zinc Company, a subsidiary of New Jersey Zinc, is again buying, after being out of the market for three months. Buying orders were increased 1,600 tons more than last week, and the market strengthened from larger orders and the closing down of one of the heaviest producing mills. Mergers and sales are being effected, which will bring the production more fully within control of the few large producing companies.

CORRECTION—In the issue of Aug. 10, under the Joplin market report, the price of Premium blende, basis 60 per cent zinc, was quoted as $41@$43. This price should have been $44@$45.

Platteville, Wis., Aug. 10, 1929

Zinc Blende	Per Ton
Blende, basis 60% zinc	$46.25
Lead Ore	
Lead, basis 80%	$85.00

Shipments for the week: Blende, 608 tons; lead, 40 tons. Shipments for the year: Blende, 21,266; lead, 1,180 tons. Shipments for the week to separating plants, 1,549 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Aug. 10 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Demand fair; prices steady.

SODIUM NITRATE — Per 100 lb., $2.07½ for spot deliveries.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Aug. 10 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45 f.o.b. works. Market firm.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the Aug. 10 issue.

Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the Aug. 10 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Aug. 10.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended August 10, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda Copper	New York	122⅛	114	118⅛	Jl. 13, Au. 19	Q 1.75
Andes Copper	New York	55½	51⅛	53½	Jl. 13, Au. 12	Q 0.75
Arisona Com.	Boston	2⅛	2⅛	2⅛	Jl. 16, Jl. 31	SA 0.25
Calumet & Aris.	New York	136½	127	128⅛	My. 31, Je. 17	Q 2.50
Calumet & Hecla	Boston	46½	42⅞	42⅝	My. 31, Je. 29	Q 1.00
Cerro de Pasco	New York	100⅛	95⅛	95⅛	Jl. 11, Au. 1	Q 1.50
Con. Coppermines	N. Y. Curb	10⅛	9⅛	10		
Copper Range	Boston	24⅛	22	22⅞	Je. 15, Jl. 15	Q 0.50
East Butte	Boston	2½	2½	2½	Dec., 1919	0.50
Granby Con.	New York	84⅛	75	77⅛	Jl. 12, Au. 1	Q 1.75
Greene Cananea	New York	182⅛	171	176	Je. 6, Jl. 1	Q 2.00
Howe Sound	New York	70	60	63	Je. 29, Jl. 15	Q 1.50
Hudson Bay	N. Y. Curb	20⅛	17⅛	19⅛		
Inspiration	New York	47⅛	42	44⅛	Je. 13, Jl. 1	Q 1.00
Isle Royale	Boston	24⅛	22⅛	22⅛	My. 31, Je. 29	0.50
Kennecott	New York	91⅛	83⅛	86⅛	My. 31, Jl. 1	Q 1.25
Magma Copper	New York	72⅛	66⅛	67½	Je. 28, Jl. 15	Q 1.25
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	46	41⅛	43⅛	Au. 1, Au. 15	Q 1.00
Mohawk	Boston	57	54	55⅛	Jl. 31, Se. 2	Q 2.00
Mother Lode	New York	3⅛	3	3	Je. 13, Je. 29	0.20
Nevada Con.	New York	49⅛	44	45⅛	Je. 14, Je. 29	Q 0.75
Noranda	N. Y. Curb	63	59	60		
Ohio Copper	N. Y. Curb	1⅛	1⅛	1⅛	Sept., 1926	0.03
Old Dominion	Boston	10⅛	9⅛	9⅛	Dec., 1918	1.00
Phelps Dodge	New York	63⅛	58	60	Je. 4, Jl. 1	Q 0.75
Quincy	Boston	47	42⅛	44	March, 1920	1.00
Roan Antelope	N. Y. Curb	44	42⅛	43⅞		
St. Mary's M. L.	Boston	39	36	36	Fe. 25, Mr. 12	2.00
Seneca Copper	New York	5⅛	4⅞	5		
Shattuck Denn	N. Y. Curb	19	15⅛	15⅛		
Sherritt-Gordon	Toronto	7.95	7.65	7.65		
Tenn. C. & C.	New York	17⅛	17	17	Au. 31, Se. 16	Q 0.25
United Verde Ex.	N. Y. Curb	16⅛	16⅛	16⅛	Jl. 2, Au. 1	Q 1.00
Utah Copper	New York	...	...	301	Je. 14, Je. 29	Q 4.00
Waite-Ack.-Mont.	Toronto	8.30	7.80	8.00		
Walker Mining	Salt Lake	5.50	4.95	5.50		
Wenden Copper	N. Y. Curb	1⅛	1	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	1⅛	1⅛	1⅛		
Amer. Z. L. & S.	New York	29	23⅛	24⅛	May, 1917	1.00
A. Z. L. & S., pfd.	New York	97⅛	95	97⅛	Je. 14, Jl. 1	1.50
Bunker Hill & S.	N. Y. Curb	126	125½	126	Ap. 25, My. 6	X 0.75
Butte Cop. & Zn.	New York	4⅛	4⅛	4⅛		
Butte Cop. Con.	Boston Curb	*31	*30	*31		
Butte & Sup.	New York	8⅛	8	8	Je. 14, Je. 29	Q 0.50
Callahan Zn-Ld.	New York	1⅛	1⅛	1⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	2.57½	2.50	2.57½	Fe. 1, 1928	K 0.10
Consol. Ld. & Zn. "A"	St. Louis	12	11	11	Je. 20, Jl. 1	Q 0.25
Constitution	Spokane	*54½	*54	*54½		
Dayrock	Spokane	3.80	3.00	3.00	Je. 20, Je. 30	0.03
Dickens Consol.	Spokane	*6⅛	*5⅛	*5⅛		
Eagle-Picher	Cincinnati	17⅛	17⅛	17⅛	Je. 30, Jl. 15	Q 0.20
Eagle-Pich., pfd.	Cincinnati	...	...	102	Je. 30, Jl. 15	Q 1.50
Eruption	Boston Curb	...	...	*12	Ja. 1, 1928	Q 0.07½
Eureka Bullion	Salt Lake	1.07½	1.00	1.02½		
Eureka Lily	Salt Lake	...	...	*33		
Eureka Standard	Salt Lake	...	...	1.42½		
Evans-Wallower	N. Y. Curb	19⅛	17	17		
Evans-Wal., pfd.	N. Y. Curb	...	...	84	Je. 20, Jl. 1	Q 1.75
Federal M. & S.	New York	...	...	280	Je., 1927	10.00
Fed. M. & S., pfd.	New York	99⅛	99⅛	99⅛	My. 24, Je. 15	Q 1.75
Gladstone	Spokane	*7⅛	*7	*7		
Golconda	Spokane	1.02	*91	*91	Je. 15, Jl. 1	0.02
Grandview	Spokane	*42½	*40	*40		
Hecla Mining	N. Y. Curb	18⅛	17⅛	17⅛	My. 15, Je. 15	Q 0.25
Highland-Surprise	Spokane	*14⅛	*14	*14⅛		
Jack Waite	Spokane	*10	*7½	*9½		
Kootenay Florence	Spokane	*16⅛	*15⅛	*15⅛		
Lucky Jim	Spokane	*9	*9	*9		
Lucky Tiger-C.	Kansas City	†3.25	†3.00	....	Au. 1, Au. 10	0.02½
Mexican Premier	Spokane	2.48	2.40	2.41		
National Lead	New York	152⅛	147⅛	147⅛	Se. 13, Se. 30	Q 1.25
Natl. Lead, pfd. A	New York	140	138⅛	138⅛	Au. 30, Se. 14	Q 1.75
Natl. Lead, pfd. B	New York	116	116	116	Oc. 18, No. 1	Q 1.50
N. J. Zinc, new	N. Y. Curb	84⅛	82	82	Jl. 20, Au. 10	Q 0.50
New Quincy	Salt Lake	3.25	2.17½	2.20	My. 15, My. 27	Q 0.10
Noble Five	Spokane	*60	*55	*55		
North Lily	Salt Lake	6.75	6.50	6.60	Jl. 16, Jl. 20	Q 0.25
Park Bingham	Salt Lake	...	...	7.75		
Park Utah	New York	6	5⅛	5⅛	Je. 14, Jl. 10	Q 0.20
Pend Oreille	Spokane	6.25	5.50	5.50		
Rico Argentine	Salt Lake	*30⅛	*30	*30⅛	No. 30, De. 15	Q 0.03
Ruth-Hope	Spokane	*36	*30	*36		
St. Joseph Lead	New York	72⅛	65⅛	67⅛	Se. 10, Se. 20	QX 0.75
Sherman Lead	Spokane	*61	*60	*61		
Silver King Coa.	Salt Lake	13.00	13.00	13.00	Je. 20, Jl. 1	0.25
Silversmith	Spokane	*9	*8⅛	*8⅛	Oct., 1926	Q 0.02
Sunshine Mining	Spokane	4.50	4.42	4.47	Je. 10, Je. 20	Q 0.05
Tamarack-Custer	Spokane	*84	*80	*80	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.50	13.25	13.50	Je. 17, Je. 29	QX 0.30
Tonopah Belmont	N. Y. Curb	...	...	*56⅛	Oct., 1925	0.05
Treadwell-Yukon	Toronto	9.50	9.50	9.50		
United Zinc Smg.	N. Y. Curb	...	...	*87⅛		
Utah Apex	Boston	3⅛	3⅛	3⅛	May 15, June 1	0.25
Utah Met. & Tun.	Boston	1⅛	1 1/16	1 1/16	Dec., 1917	0.30
Whitewater	Spokane	*58	*55	*55		
Yellow Pine	Los Angeles	....	....	*8	Dec., 1925	QX 0.04
GOLD						
Alaska Juneau	New York	7⅛	5⅞	7		
Barry-Hollinger	Toronto	*30	*27	*28		
Central Manitoba	Toronto	*45	*42	*42		
Cresson Consol.	N. Y. Curb	*62⅛	*56⅛	*56⅛	Mr. 30, Ap. 10	Q 0.02
Dome Mines	New York			10⅛	Jl. 20,	Q 0.25
Golden Cycle	Col. Springs	†1.85	†1.79	....	Fe. 15, Mr. 1	0.04
Gold Hill	Toronto	...	...	1⅛		
Hollinger	Toronto	7.00	6.50	7.00	Jl. 26, Au. 12	FW 0.05
Homestake	New York	76	75⅛	76	Jl. 20, Jl. 25	M 0.50
Kirkland Lake	Toronto.	*96	*83	*91		
Lake Shore	Toronto	26.00	25.50	25.50	Je. 1, Je. 15	Q 0.20
McIntyre-Porc.	New York	15⅛	15⅛	15⅛	Au. 1, Se. 2	Q 0.25
Portland	Colo. Springs	†*9½	†*8	.....	April, 1927	0.02
Rand Mines	New York	35	35	35	Fe. 21, '28	Am. Sh. 1.52
Siscoe	Toronto	*73	*66	*69⅛		
Sylvanite	Toronto	1.19	1.07	1.10		
Teck-Hughes	Toronto	8.30	8.15	8.15	Jl. 18, Au. 1	0.15
Tom Reed	Los Angeles	*75	*70	*71	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅛	1⅛	1⅛		
Vipond Consol.	Toronto	*90	*82	*85	April, 1927	0.03
Wright-Hargreaves	Toronto	1.90	1.80	1.85	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19⅛	17⅛	19⅛		
Castle-Trethewey	Toronto	*30⅛	*30	*30⅛		
Consol. Cortes	N. Y. Curb	...	...	*12⅛		
Dolores Esperanza	N. Y. Curb	*81⅛	*75	*75	July, 1923	0.05
Keeley	Toronto	*46	*46	*46	Mr. 15, 1928	0.04
Mining Corp.	Toronto	4.75	4.25	4.35	My. 30, Je. 13	0.12½
Montana-Idaho	Spokane	*7⅛	*7⅛	*7⅛		
N. Y. & Hond. Ros.	N. Y. Curb	17⅛	17⅛	17⅛	Jl. 17, Jl. 27	QX 0.50
Nipissing	N. Y. Curb	2⅛	2⅛	2⅛	Je. 29, Jl. 20	Q 0.07½
Premier Gold	N. Y. Curb	1⅛	1⅛	1⅛	Je. 13, Jl. 3	Q 0.06
Tonopah Exten.	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	2⅛	2⅛	2⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	...	...	*56⅛		
Yukon Gold	N. Y. Curb	*87⅛	*62⅛	*87⅛	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	125⅛	118⅛	121⅛	Oc. 18, No. 15	Q 1.50
Beth. Steel, pfd, 7%.	New York	122	121⅛	126	Se. 6, Oc. 1	Q 1.75
Cleveland-Cliffs	Cleveland	98	97⅛	97⅛	Je. 6, Je. 15	5.00
Colo. Fuel & Iron	New York	71⅛	64	64⅛		
Colo. F. & I., 1st pfd.	New York	133	133	133	Au. 10, Se. 26,	Q 2.00
Great Northern Iron.	New York	31	28⅛	29	Dec. 15,	K 2.00
Inland Steel	New York	96⅛	92	93⅛	Au. 15, Se. 1	Q 1.87½
Republic I. & S.	New York	112	105	107⅛	My. 11, Je. 1	Q 1.00
Republic I. & S., pfd.	New York	110	110	110	Je. 12, Jl. 1,	Q 1.75
Sloss-Sheffield S. & I.	New York	59⅛	55⅛	55⅛	Mr. 11, Mr. 20,	Q 1.50
Sloss-Sheff. S. & I., pfd.	New York	78⅛	78⅛	78⅛	Je. 20, Jl. 1,	Q 1.75
U. S. Steel	New York	221⅛	209⅛	218	Au. 29, Se. 28,	Q 1.75
U. S. Steel, pfd.	New York	140⅛	139⅛	140⅛	Au. 5, Au. 30,	Q 1.75
Virginia I. C. & C.	New York	21	20	20	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	42	40	40	Jl. 16, 1928	SA 2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	539⅛	480	480		
Alum. Co. of Amer., pf.	N. Y. Curb	108	106⅛	107	Mr. 15, Ap. 1,	Q 1.50
American Metal	New York	74⅛	68	70⅛	Au. 21, Se. 1	Q 0.75
Amer. Metal, pfd., 6%	New York	125	122	125	Au. 21, Se. 3	Q 1.50
Amer. Sm. & Ref.	New York	119⅛	110⅛	114	Je. 30, Jl. 12	Q 1.00
Amer. Sm. & Ref., pfd.	New York	133⅛	132⅛	132⅛	Au. 3, Se. 1	Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	41⅛	37⅛	37⅛		
Asbestos Corp.	Montreal	11⅛	10	10	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	31	31	31	De. 31, Ja. 15	Q 1.75
Consol. M. & S.	Montreal	400	388	390	Je. 29, Jl. 15,	SA X 6.25
De Beers Consol.	New York	22⅛	22⅛	22⅛	Jl. 23, Jl. 26,	Q 0.96
Federated Metals	N. Y. Curb	32	32	32	Je. 25, Jl. 5	Q 0.75
Freeport Texas	New York	44	41⅛	42	Jl. 5, Au. 1	Q 1.00
Int. Nickel Can.	New York	53⅛	48⅛	50⅛	Je. 1, Je. 29	Q 0.20
Int. Nickel, pfd.	New York	...	...	122	Jl. 1, Au. 1	Q 1.75
Mayflower Assoc.	N. Y. Curb	83	80	82		
Metal & Mining	N. Y. Curb	21⅛	19⅞	20⅛	Je. 20, Jl. 1	Q 0.30
Newmont	N. Y. Curb	218	205⅛	212	Je. 29, Jl. 15	Q 1.00
Patiño M. & E.	New York	41⅛	38⅛	39⅛	My. 31, Jn. 28	4a
So. America G. & P.	N. Y. Curb	2⅛	2⅛	2⅛		
Texas Gulf Sulphur	New York	72⅛	70	70	Se. 2, Se. 16	Q 1.00
U. S. Sm. R. & M.	New York	58⅛	52	54	Jl. 5, Jl. 15	Q 0.87½
U. S. Sm. R. & M., pfd.	New York	52	51	52	Jl. 5, Jl. 15	Q 0.87½
Vanadium Corp.	New York	86⅛	77⅛	78⅛	Au. 1	Au. 15 Q 0.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED July 30, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	59/6	58/9	59/—	Nov., 1926	4 p.c.(d)
Aramayo Mines (25 frs.)	61/10½	60/—	61/3	Aug., 1929	5 p.c.(e)
Burma Corp (10 rupees)	18/3	17/9	18/—	July 1929	9 annas*
Bwana M'Kubwa (5s)	21/—	20/1½	20/6		
Camp Bird (2s)	2/—	1/9½	2/—	April, 1928	16⅔ p.c.
El Oro (5s)	3/—	2/6	3/—	Nov., 1924	2½ p.c.*(c)
Frontino & Bolivia (£)	7/1½	7/1½	7/1½	Jan., 1929	3½ p.c. (e)
Mexican Corpn. (£1)	16/4½	15/7½	16/—		
Mexico Mines of El Oro (£1)	5/—	4/—	5/—	Dec., 1926	3½ p.c.*
Mount Isa (£1)	42/6	37/1½	38/9		
N'Changa Copper Mining. (£1)	71/6	63/1½	67/6		
Oroville Dredging (4s)	1/10½	1/7½	1/10½	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	207/6	190/—	202/6		
St. John del Rey (£1)	16/7½	16/—	16/3	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	35/6	34/9	35/—	June 1929	15 p.c.
Santa Gertrudis (£1)	10/3	9/4½	10/—	July 1929	7½ p.c.
Selukwe (2s. 6d.)	6/11½	6/4½	6/6	April, 1917	6¾ p.c.
S. Amer. Copper (2s.)	3/1½	2/10½	2/10½	Nov. 1917	75 p.c.
Tanganyika (£1)	60/—	56/3	59/4½	July, 1928	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	10,740	10,700	10,700	April, 1929	300 fr. (f)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. (d) U. S. Dollars. (e) July, 1929, ex ½d. return of capital. (e) on original £1 shares.